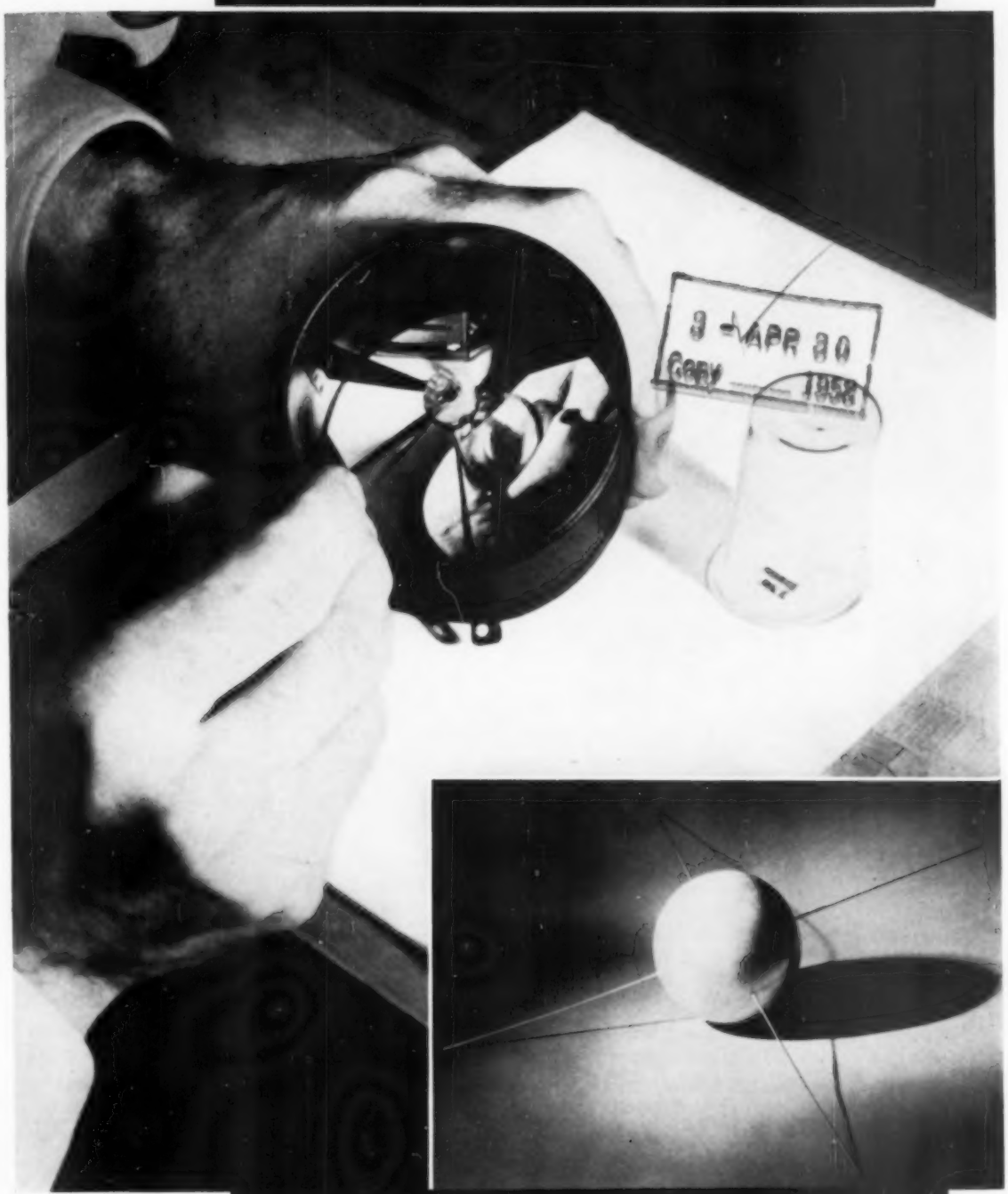
MARCH 31, 1958

PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING



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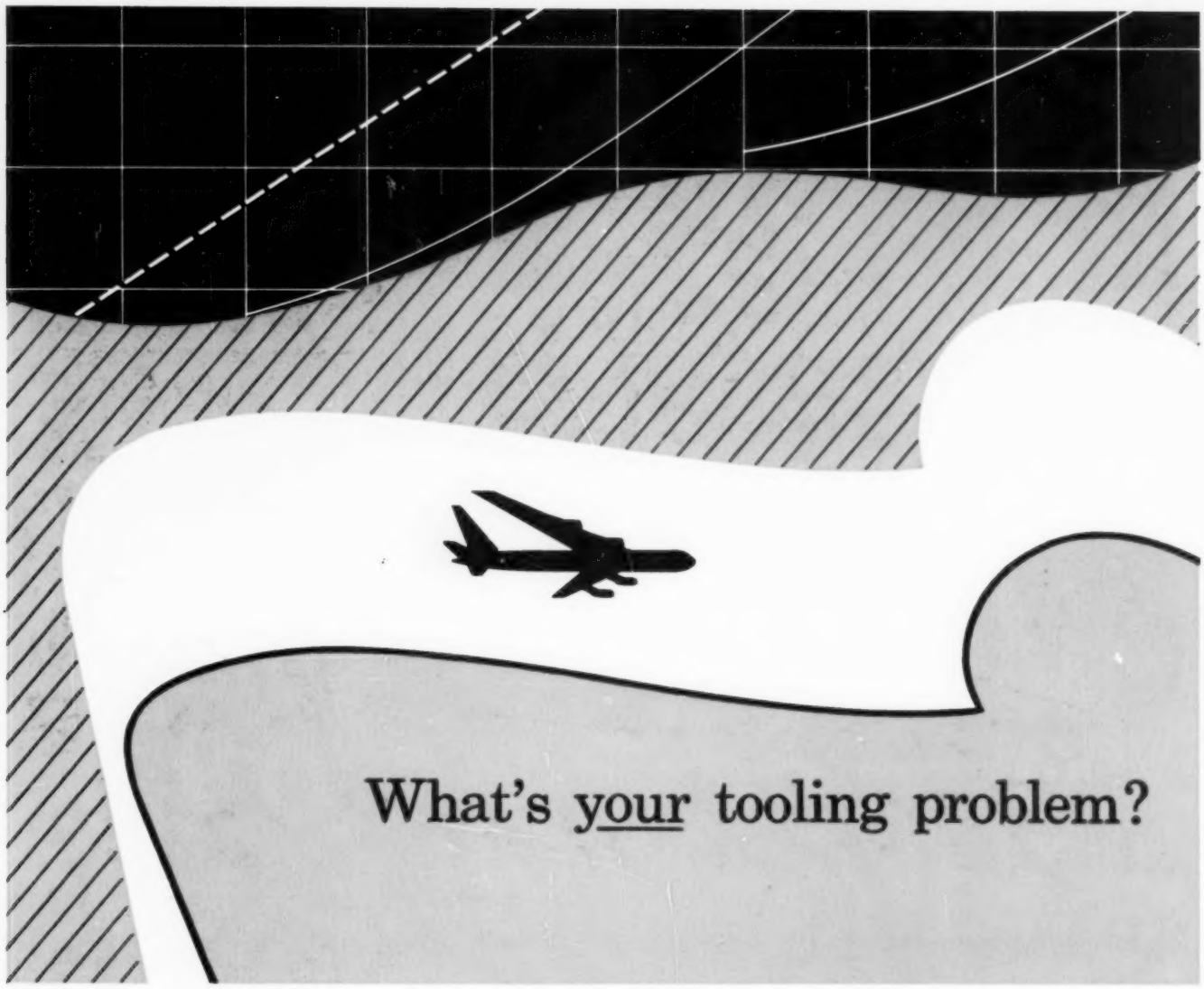

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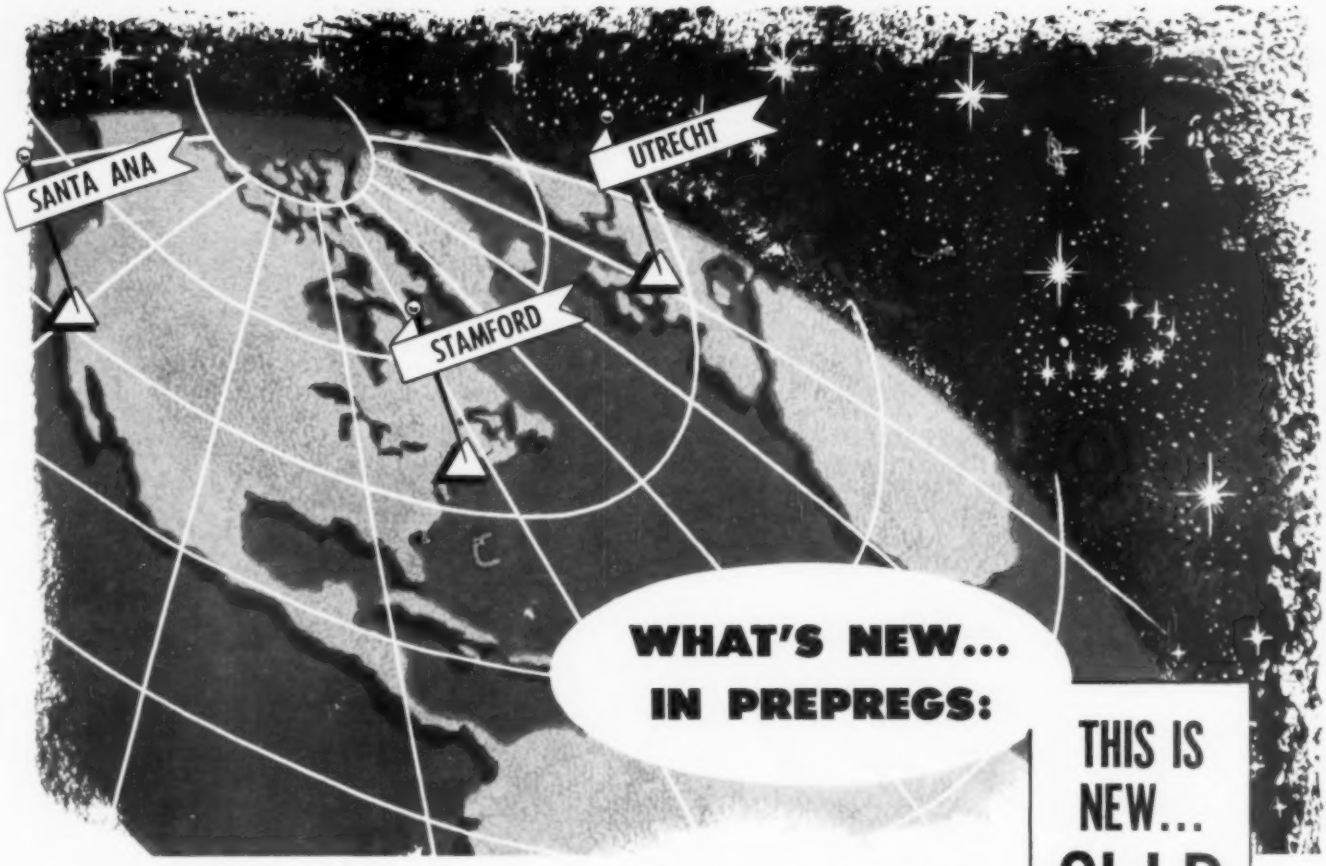

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THIS IS NEW... 91-LD

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- **Thermal Coefficient of Expansion essentially the same as steel . . .**

For specific recommendations concerning materials and material specifications, engineering assistance on any individual application is available upon request. Merely write: Engineering Department, U. S. Polymeric Chemicals, Inc., Stamford, Conn.

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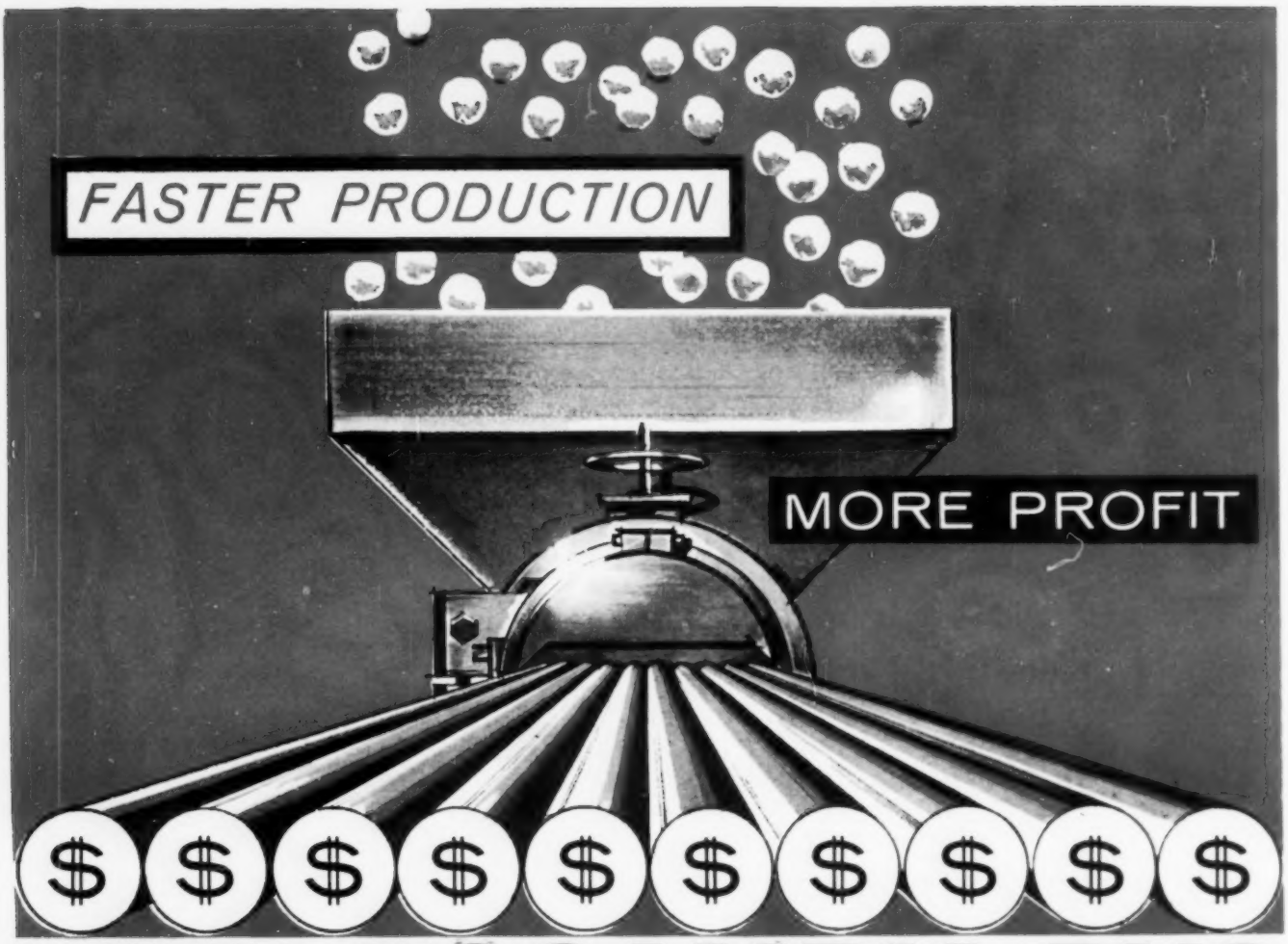

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PLASTICS TECHNOLOGY

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MARCH 1958 VOLUME IV NUMBER 3

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Cover courtesy of: National Vulcanized Fibre Co.

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The opinions expressed by our contributors do not necessarily reflect those of our editors

APR 1 1958

Letters to the Editor

The following articles will be published in the April issue:

Advances in Continuous Vacuum Forming Processes. M. J. Kalahar, Kal Plastics, Inc., Beaverton, Mich.

Roll-Neck Bearing Lubrication for Rubber and Plastics Calenders. K. J. Gooch, lubr. engr. & asst. division engr., and W. C. Whittum, chief engineer, Farrel-Birmingham Co., Inc., Ansonia, Conn.

Use of Radiation Gages in Plastics Extrusion Processes. G. I Doering, mgr., Chemical Industries Division, Industrial Nucleonics Corp., Columbus, O.

The Thirty Years of Plastics Impact Testing—Part II. R. F. Westover, member of technical staff, Bell Telephone Laboratories, Murray Hill, N. J.

Advances in Phenolic Materials and Processes During 1957. A. P. Landall, supervisor of technical service engineering, Phenolic Prods. Sales, General Electric Co., Pittsfield, Mass.

•

The Thirty Years of Plastics Impact Testing—Part 1. (p. 223)
This first of two parts analyzes and discusses past accomplishments in plastics impact testing and begins a discussion of the present status of the field. Factors discussed include Izod and Charpy methods, deformation and fracture of specimens, broken-half tossing energy, and effects of blow speed, specimen grip, testing speed, and energy losses.

Arc Resistance of Epoxies. (p. 228)
Test results on the effects of various fillers in epoxies indicate that there is a degree of "filler settling" that causes a difference between top and bottom surfaces of cast specimens in arc resistance. This emphasizes the need for product design that will take advantage of this settling in product areas requiring maximum arc resistance values.

Cutting Production Costs and Time with Epoxy Resin Press Dies. (p. 232)
Causative factors for the selection of epoxy resins to make dies for the press forming of aluminum sheets in the production of aircraft by Grumman Aircraft are explained. Operations in making these dies are discussed and pictured.

Importance of Fabrication on the Properties of Silicone-Glass Laminates. (p. 235)
Variations in laminate properties caused by washing of glass cloth, glass tensile strength, catalyst concentration, resin content, pre-cure time and temperature, and other factors are discussed in detail.

Are Technical Sheets Too Technical?

Dear Sir:

I can sympathize with reader G. E. LaCaven (Nov. issue, pg. 860) who deplores the lack of how-to-do-it information from the basic materials suppliers. There are a few exceptions: Rohm & Haas has easy to understand booklets on how to work with acrylic sheet; Bakelite has several fine booklets, mainly in the liquid vinyls field; Monsanto on several resin powders, also; and Ferro Corp. has a book on vinyl plastisols covering the entire conversion operation.

In sharp contrast, many technical sheets from other suppliers of resins, liquids, and sheetings are "just that, and no more," and are of no help to their sales departments. Usually, such sheets are written with ponderous words that are not understandable to anyone but another plastics chemist. There seems to be an effort to prove to the boss and fellow scientists that they, too, "went to college." After diligent study, the semi-technical product manufacturer can translate many of the sheets into useful information. But, as Mr. LaCaven implies, there is no common denominator of comparison in order to choose one product from the field to fit his job. This still is a "cut and try" that the customer ultimately pays for.

My suggestion is for each page-size advertiser to set aside each month a half-page box giving a case history of how one of their customers used the product successfully, and giving his name, photo, etc.; pictures or sketches of the job; breakdown of costs; names of non-competing suppliers of other ingredients or tools; and any other text to complete the story digest.

Frank Pray, Owner,
Technicraft Co.
Boston, Massachusetts

(Mr. Pray brings up an interesting, although somewhat specialized, case. We would be interested in receiving comments on this matter from our readers. Naturally, these comments will not be published unless released to us by the writers.—Editor)

Information Wanted

Dear Sir:

I am interested in the metallized acetate film, called Lumiline, produced by Rhone-Polene, France. ("News from Abroad," Nov. issue, pg. 926)

The article in your magazine states that this Lumiline has a surface like a fine mirror; the mirror is not just a film on the surface, but goes all the way through.

I think there is a product made in the U. S. where the plastic is treated when in a liquid state to a metal vapor in a vacuum chamber; stirred while in the chamber; and then taken out and used as a lacquer that has a mirror-like effect.

Can you help me on this?

Warren Chester
Costa Mesa, Calif.

• • •

(Can our readers provide any assistance in this matter?—Editor)

• • •

Dear Sir:

Would you please advise us of companies who manufacture small parts from polyamides, also their addresses.

R. J. Sherwood
Waller Corp.
Chicago 6, Ill.

• • •

Dear Sir:

We are interested in a source of supply of molded rings—2¾ inches inside diameter by 3¼ and 3⅜ inches O.D. Thickness to be one-quarter inch, and material to be high-impact styrene.

(Identity withheld)

(All replies will be forwarded to the inquirer.—Editor)

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

"Quote . . . Unquote"

Plastic Dies

"It has been said that in order to get into the plastic die business it was necessary to have only a garage, a pot and mixing paddle, and a very convincing salesman. Hence, the term 'plastic die' became a very dirty phrase with many customers. However, many of the initial problems and prejudices have been overcome because of advances in materials, techniques, and a much more realistic approach to various problems by plastic die builders.

"The plastic die industry, like all other new industries, has had and is having its lumps. But the very fact that it has survived and is increasingly expanding its activities proves that all is not bad with plastic dies and they have a definite place.

"Plastic dies are being used by many corporations and they are doing a good job. In designing these plastic dies, some thought must be given to problems that will be encountered in production. For instance, it is possible to make a plastic draw die to draw almost any panel successfully out of steel that is 16 gauge or less, provided your requirements are not too high for the conditions encountered. If the stamping is relatively free from sharp radii and embossments, it is possible to draw many thousands of pieces over a plastic punch. For other stampings having severe radii or surface transitions, the addition of local metal inserts might be the answer. However, if the requirement would be only a few hundred pieces, the wearing down of the die ring surface would not, in all probability, be too great to complete the requirements.

"At the initial planning of a plastic die program, these factors must be taken into consideration:

(1). How many pieces are to be formed;

(2). How much work (variation of surface or shape) is the die to accomplish; what are the tolerances;

(3). What is the end product; is good appearance, free from surface defects, essential;

(4). Does the design of the part readily lend itself to the use of plastic for building the die for the quantities desired;

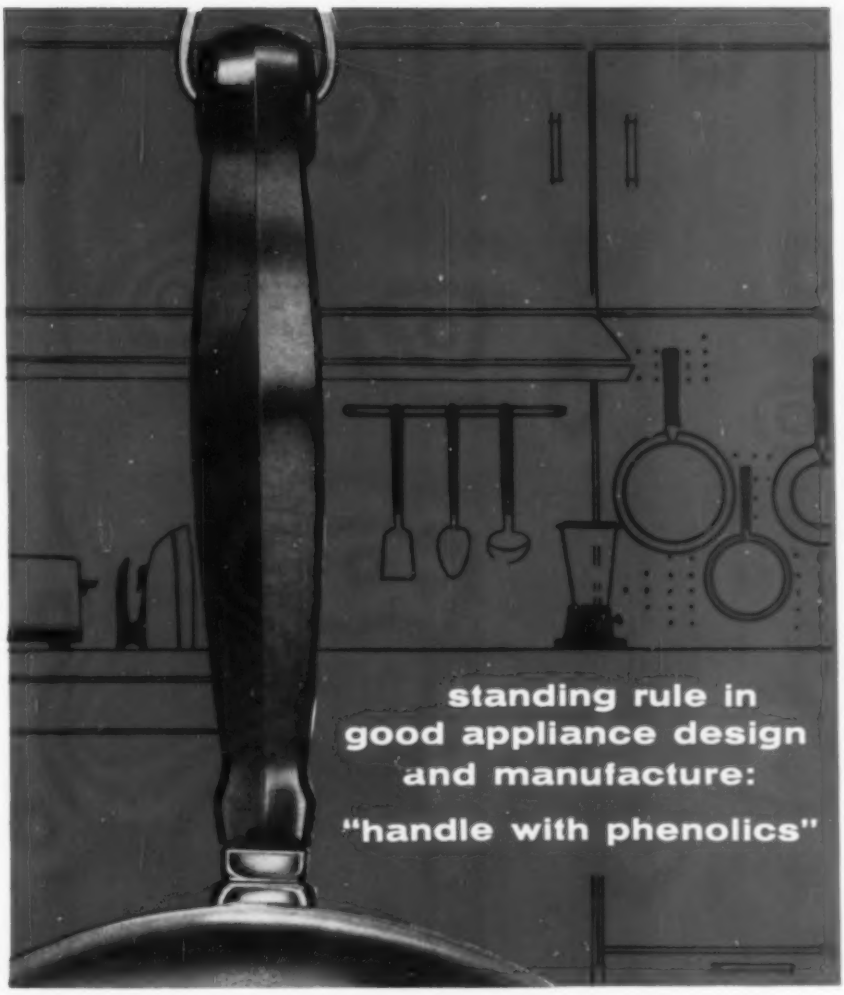
(5). Will the severity of the drawing operation require metal inserts in the ring, the pad or the punch;

(6). How soon are the production pieces needed, and at what rate;

(7). Considering that this may be a part of a die building program, is there enough skilled die 'know-how' and machine capacity and enough skilled mechanics available if conventional die construction methods are followed.

(8). How much money is available for the die building program."

W. J. Esdale
Allied Products Corp.
Detroit, Michigan



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To assure molded products that are cool to the touch . . . gleam with good looks . . . resist wear as well as rust as well as shock as well as acids and grease . . . the exceptional value of *phenolic* molding compounds to the appliance industry has long been demonstrated.

Designers and molders have learned to handle the problem with ease and economy. To handle with confidence in the uniquely ideal properties of phenolics . . . bred to withstand the rigors of life in kitchen and laundry room. To handle, in more and more instances, with *Plenco*.

Appliances, of course, cover a lot of territory. But so do Plenco resins and the services of Plenco engineers. In the variety, versatility and quality-controlled excellence of Plenco phenolic molding materials, industry men in all fields find the answer to their most demanding requirements.

You should find it well worth while to consult with our technical staff.

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Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and compounds

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There's a hidden ingredient in every Argus product. It's the basic, bred-in-the-bone curiosity about your problems that enables Argus research to keep turning out better and better vinyl plasticizers and stabilizers at lower and lower cost.

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If you want the *right* answers, ask Argus. We'll find them for you in our regular line of Mark stabilizers and Drapex plasticizers – or in basic, original research done on your product by our Technical Service Staff. Write for technical bulletins and samples.

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MARCH
1958

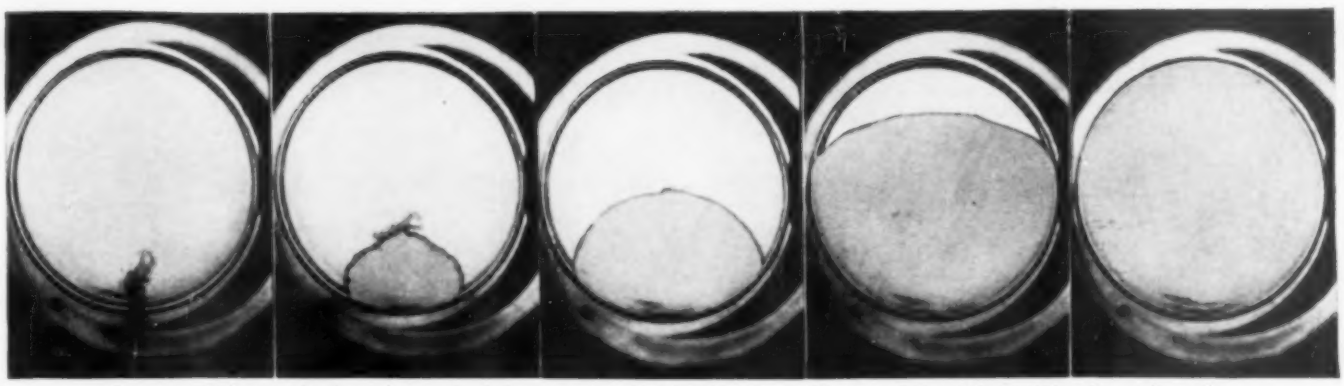
DOW

Plastiatrics

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

BEHAVIOR OF POLYETHYLENE INSIDE MOLD CAVITY STUDIED

GLASS WINDOW IN MOLD ALLOWS CLOSE STUDY OF FLOW BEHAVIOR PATTERNS



Sequence of photographs above shows polyethylene of melt index 2 jetting into mold cavity at left and finally filling the mold at right.

A careful study of molten polyethylene inside the mold cavity has provided important new information on its behavior patterns. For example, as the material enters the mold and starts to cool, crystallization begins at once (see chart below). One result of this crystallization is the formation of a weak front which, due to pressure from incoming material, breaks up and tends to re-form inside the mold. The motion pictures taken through the glass window (see photos above) show several other interesting features:

1. Polyethylene has a tendency to jet when entering into the mold cavity.

2. The finish of the molded part may show blemishes where the material in the jet and the molten front meet and do not weld properly.

3. As the molten material flows into the mold, curvature of the front does not reverse, indicating that polyethylene does not wet the glass mold walls.

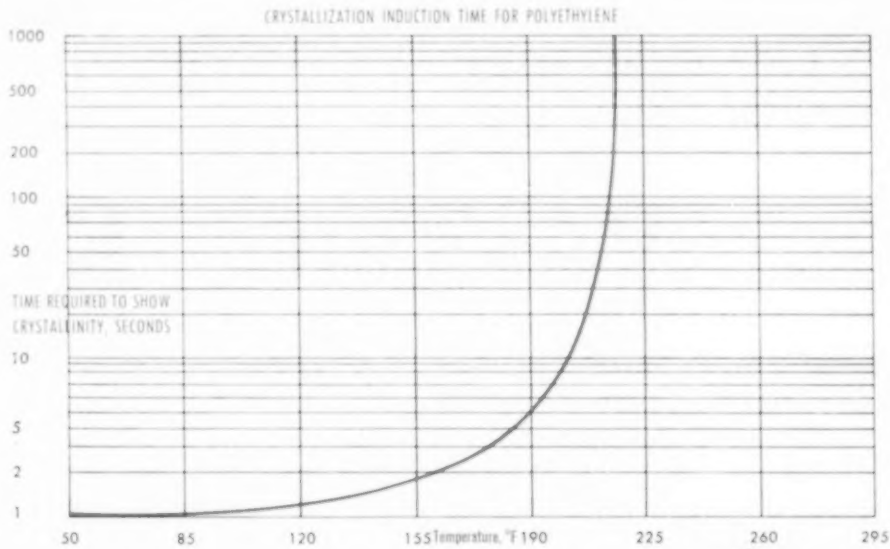
4. When polyethylene is forced against the mold wall and becomes solid, it does not stop flowing but is scraped along the mold walls in the direction of flow.

5. Polyethylene has a tendency to pack in the mold under a wide range of operating conditions.

Dow Technical Service Engineers have made a thorough study of the performance characteristics of polyethylene in injection molding. This is a part of a continuing series of Plastiatrics studies covering every phase of plastics formulation, design, molding and finishing. For your copy of "Injection Molding Polyethylene", write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Department 1519G.

DOW POLYETHYLENES
INJECTION MOLDING GRADES

LOW DENSITY	MELT INDEX	
700 M	7.0	
900 M	20	
410 M	1.5	
610 M	5	
710 M	12	
910 M	28	
INTERMEDIATE DENSITY		
770 M	8	
771 M	8	—slip characteristics
990 M	20	
991 M	20	—slip characteristics
1000 M	35	



YOU CAN DEPEND ON DOW

TORTURE CHAMBER FOR MOST PLASTICS The unbranched, long chain molecules of Fortiflex increase heat resistance to above the boiling point of water!

SHAPE-HOLDING RIGIDITY Higher density Fortiflex gives housewares greater structural strength.

BEAUTIFUL SURFACE LUSTRE

PLASTICS RESEARCH...

"Controlled Polymerization" gives Fortiflex its smooth, lustrous surface. The waxy feeling has been scientifically eliminated.

A CAREFREE PLASTIC

The molecules of Fortiflex pack closely in linear formation . . . give Fortiflex an unsurpassed combination of rigidity and toughness.

YOU WOULDN'T TRY THIS WITH OTHER PLASTICS

In boiling water or in freezer compartments, Fortiflex is virtually unaffected by temperature variations.

writes a new recipe for Housewares

Two years ago there was no plastic for housewares like Fortiflex! That's because Fortiflex is the product of a recent and exciting breakthrough in polymer research—called "controlled polymerization." This method of molecule building produces a material that is far superior in toughness, in heat resistance, in stiffness, and in surface lustre. The pictures on this page demonstrate how Fortiflex, the latest in scientific plastics research, offers the housewares industry new opportunities for vastly improved products and greater design versatility.

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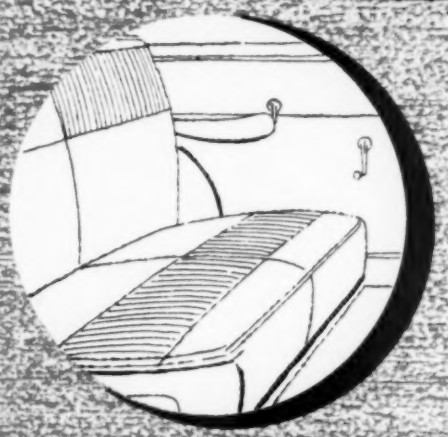
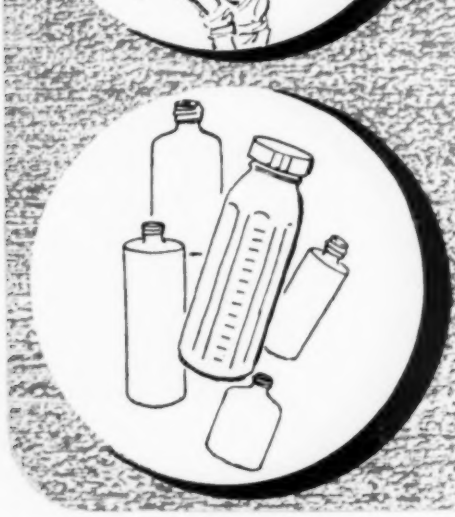
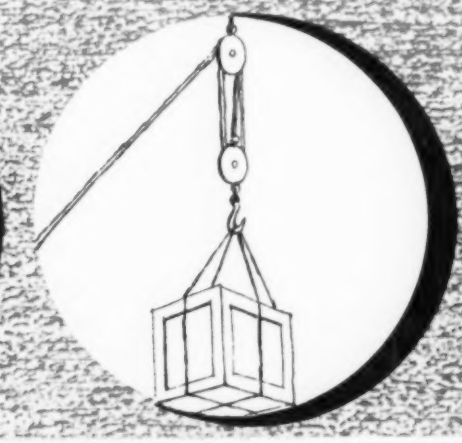


From years of Hercules research in the development of organometallic catalysis systems have come the two new polyolefins that are the talk of the plastics industry — Hi-fax high-density polyethylene and Profax polypropylene.

The broad combination of properties of these two materials makes available a perfect team that is almost certain to meet your requirements. Already well established, Hi-fax is now being used in such applications as toys, packaging, fabrics, wire coatings, pipe, and

HERCULES





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a Choice of Polyolefins

Lightest of all plastics—hard and lustrous surface finish—resists deformation at 300°F.—rigidity—high impact strength—easy to mold—broad range of rich colors.

pro-fax
HERCULES TRADEMARK

wherever the unusual characteristics of high-density polyethylene result in a superior end product.

Now Hi-fax is complemented by Pro-fax, America's first polypropylene. This amazing new material will greatly broaden the markets for plastics, especially those now served by wood, metal, and glass.

Why not learn more about these two pace-setting plastics? For detailed information on properties and uses, call or write Hercules.

Cellulose Products Department

HERCULES POWDER COMPANY

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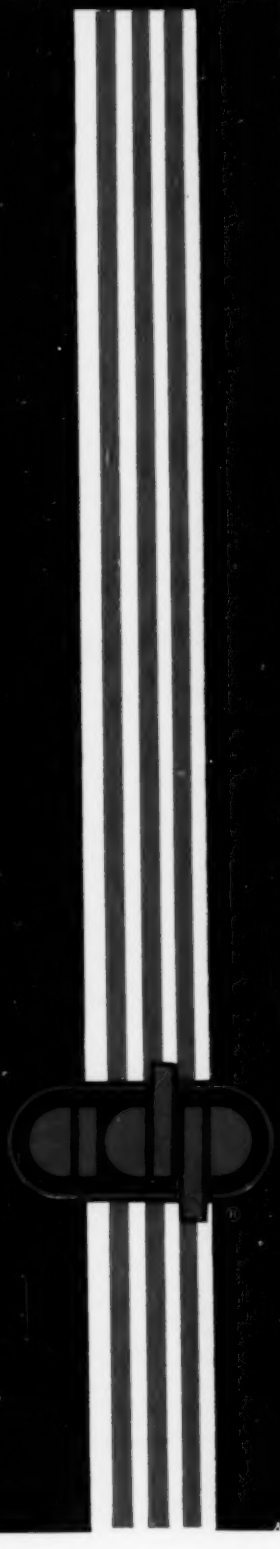

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A Unit of Acheson Industries, Inc. Plants at Orange, Tex., Philadelphia, Pa., Xenia, O.

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HOW COME THE ALPHA DELT SNOW SCULPTURE HASN'T MELTED?
SOME CRAZY CHEM MAJOR MADE IT OUT OF SOMETHING CALLED POLYURETHANE FOAM!
D
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You can make almost anything better out of polyurethane foam. To make this remarkable material Reichhold supplies a complete and highly versatile system: POLYLITE 8601 — polyester resin, POLYLITE 8621 — polyisocyanate, and a catalyst. The system allows self-curing at room temperatures; yields a hard, rigid foam with a high strength-to-density ratio and exceptionally uniform structure of closed cells. Write to RCI for full details and suggested formulations. Ask for *Technical Bulletin PR-15-R.*

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Chemical Division GENERAL THE GENERAL TIRE & RUBBER CO VYGEN

THE GENERAL TIRE & RUBBER COMPANY
CHEMICAL DIVISION • AKRON, OHIO

INTER-OFFICE MEMORANDUM

FROM: Chief Chemist

TO: Production Superintendent

SUBJECT: VYGEN PVC RESIN

PVC Resins from General Tire's Chemical Division recently were brought to our attention, and have been evaluated by the product chemists. Test results are most promising, and indicate the advisability of factory trials whenever possible.

VYGEN 105 will fit very nicely into our injection molding program. It has excellent flow characteristics, very good heat stability, and provides a glossy surface. We recommend it also for extrusions requiring a very high gloss.

VYGEN 110 is a general purpose resin with extremely good heat stability. This resin, when used in calendering the pastel shades, will overcome the rejects you have had due to color drift. It is ideal for calendered film, sheeting and coated fabrics.

The third resin in this group, VYGEN 120, is extremely interesting. It can be dry-blended with polymeric plasticizers and extruded from the dry blend. This one can save us money by eliminating the pelletizing operation. It has the best heat stability of any resin we have ever tested, and should be used in the clear extrusions where you are presently having trouble with stability. Incidentally, Vygen 120 has excellent electrical properties. We are working on it now for the new job coming up in this area, and will keep you posted on further developments.

VYGEN 161 should be tried for making a pigment-plasticizer-resin masterbatch. This is a color-addition method far superior to the color paste and dry color techniques we have been using. The color masterbatch is much easier to handle and weigh, allowing more efficient operation and improved color control.

After you have gone over the attached test results, we would like to discuss with you areas and applications where these specialized resins can fit into our production picture.

A. B. Bourgeault

Chief Chemist

PLASTICS TECHNOLOGY

EDITORIAL:

MARCH, 1958

Announcing the Inauguration of

"Achievement Awards in Plastics Technology"

Beginning April 1st, we are pleased to announce the inauguration of a program of Achievement Awards in Plastics Technology, and invite entries in this competition.

The program consists of two categories, as follows:

(1). New developments in plastics processing. This includes all methods whereby a plastic material, as furnished by a materials supplier, is molded, calendered, formed, or otherwise shaped into a finished or semi-finished form.

(2). New developments in plastics fabricating. This includes assembly operations, decorating, bonding, and other methods whereby a semi-finished part is converted or otherwise transformed into its final, finished form.

•

When we first discussed the possible starting of this program and the many problems and questions involved, as mentioned in our December 1957 Editorial, we asked for comments and suggestions from our readers. All replies received by letter or telephone have been uniformly enthusiastic. In fact, we were flooded with suggestions, and spent the interim months in serious consideration of each comment. Now we are ready to begin.

Starting with the next issue, we will endeavor to select an Award winner in one or both of the two categories. Each winner will be illustrated and described in detail, with proper credit given to the responsible person and company involved. This Achievement will be given an appropriately prominent position in the magazine and, in addition, will automatically become an entry in the yearly round-up to choose the grand award winner for the year ending on March 31, 1959.

This grand award winner will be chosen from the year's monthly Award winners by a committee of judges consisting of our editors and our Editorial Advisory Board members.

•

The submittance of entries in the Achievement Award program is cordially invited from our readership and all other persons and companies in the plastics industrry. These entries should consist of letters describing the developments that are proposed for inclusion in the program. We will consider each letter, and then contact each writer to discuss the detailed information and illustrations that should be provided, and the person or company that should be given due recognition for this advance in the technology of plastics by means of the monthly Achievement Awards that we will publicize.

We plan to make the Awards an annual program and, as a major reason for instituting the program, endeavor to give due credit and recognition to the individuals and companies who are spearheading the campaign to provide the impetus and engineering advances needed to promote plastics as products of a mature industry cognizant of its responsibilities.

Arthur M. Merrill
Editor

19,000 COMPETITORS PRIVATE BUSINESS CAN NEVER LICK

They're the government operated businesses supported by your taxes

PLASTICS TECHNOLOGY believes you may want to do something about it

The Federal Government operates over 19,000 "businesses," many of which compete directly with tax-paying private enterprise.

Some of these bakeries, laundries, factories (ice-cream, eye glasses, tape, paint, etc.) may be justifiable. But many government "businesses" are taking business away from you. To make it worse, many of them claim to be operating at a "profit" when they are actually being subsidized by you—the taxpayer.

How 500 of these "businesses" were abolished

The bipartisan Hoover Commission strongly recommended the closing of needless government businesses and business-type establishments. The demise of the Reconstruction Finance Corporation saved $474 millions. Some 500 business activities, in the Defense Department alone, have been closed since this recommendation was submitted.

But this is not enough. Positive action by Congress is still needed.

What you can do

As one of the members of *Bill Brothers Publishing Company*, we are passing this information along to our own readers.

You can help get the government out of competition with private business. H.R. 5826 awaits action by the House Government Operations Committee and S. 1539, a similar measure, awaits action by the Senate Government Operations Committee. You can ask your senators and representative to support this declaration of congressional policy against government encroachments in areas properly belonging to business.

If you would like to be posted on other Hoover Commission recommendations up for legislative action, now or in the months ahead, you can become a member of the Citizens Committee for the Hoover Report, a non-profit, bipartisan organization with thousands of volunteer members.

There is no fee, no obligation, though many members do elect to contribute. You can start by using the coupon below:

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Yes, I would like to receive, without obligation, a membership card for the *Citizens Committee for the Hoover Report* and a copy of the Committee Member's Handbook, Reorganization News, and other current cost-cutting legislative information.

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BILL BROTHERS PUBLICATIONS

Why best-selling plastic products of tomorrow begin with Glidden pigments today

In an increasingly competitive market, the top-quality products you produce—and *sell*—must appeal with every color advantage possible.

Colors must be bright and clean. Opacity and hiding power are basic. Uniformity of tone value must be consistent. And colors must be locked in for maximum resistance to fading and bleeding.

Glidden pigments fulfill all of these requirements. Glidden *Zopaque* Titanium Dioxide is the whitest white pigment available. New *Mercadmolith* (mercury-cadmium) and *Cadmolith* (cadmium-selenium) colors offer a combination of advantages found in no other reds and yellows. They are soft, easy to grind; insoluble in all vehicles; high in heat resistance.

Be sure to specify Glidden—a leading supplier of finest pigments to industry.

By the makers of Sunolith Lithopones . . . Euston White Lead . . . Resistox Copper Pigments

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The lighter side of rubber and plastics . . . colorwise, of course . . . is achieved through the rutile titanium dioxides TITANOX* RA, TITANOX-RA-50, and TITANOX-RA-NC.

Here's why: these leading white pigments lighten and opacify colors, whiten and opacify white stocks, regulate translucency or opacity, and contribute to durability. In addition, they lighten the burden of processing through ease of dispersion and uniformity of all properties. Our Technical Service Department can help you with any pigmentation problem. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; offices and warehouses in principal cities.

5721

TITANOX

TITANIUM PIGMENT CORPORATION

Subsidiary of NATIONAL LEAD COMPANY

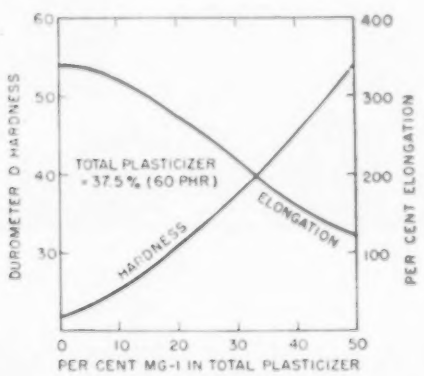
*TITANOX is a registered trademark for the full line of titanium pigments offered by Titanium Pigment Corporation.

Plastisols with MONOMER MG-1 make new hard vinyl plastics

Now, with Monomer MG-1, you can make plastisol-fabricated vinyls with a hardness range never before possible. This means MG-1 may improve such products as:

- *flooring*
- *doll parts*
- *toys and balls*
- *wire and rack coatings*
- *tank linings*
- *foams and sponges*
- *gaskets*
- *and other products that require hard vinyl plastics made by plastisol techniques.*

Here's why! Monomer MG-1 is a high-boiling, low viscosity dispersant for polyvinyl chloride resins. Fluid plastisols are prepared with MG-1 in combination with conventional plasticizers. MG-1 polymerizes during the normal plastisol fusion cycle to produce hard plastics. The concentration of MG-1 controls the flexibility or rigidity of the finished product. This graph shows the effect of MG-1 on plastisol films.



Plastisol fabricated vinyls made with Monomer MG-1 also have these outstanding properties:

- *improved oil extraction resistance*
- *reduced "rub-off"*
- *improved electrical properties*
- *reduced volatile loss*
- *increased gloss*
- *improved scuff resistance*

U. S. Patent 2,618,621 covers the use of Monomer MG-1 in vinyl chloride dispersions. This patent is now being licensed by UNION CARBIDE.

If plastisol fabrication is your business, Monomer MG-1 may open new markets for you. Write for technical data, samples, and licensing information. Address Union Carbide Chemicals Company, Department B, 30 East 42nd Street, New York 17, New York. In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Toronto.

"Union Carbide" is a registered trade-mark of Union Carbide Corporation.

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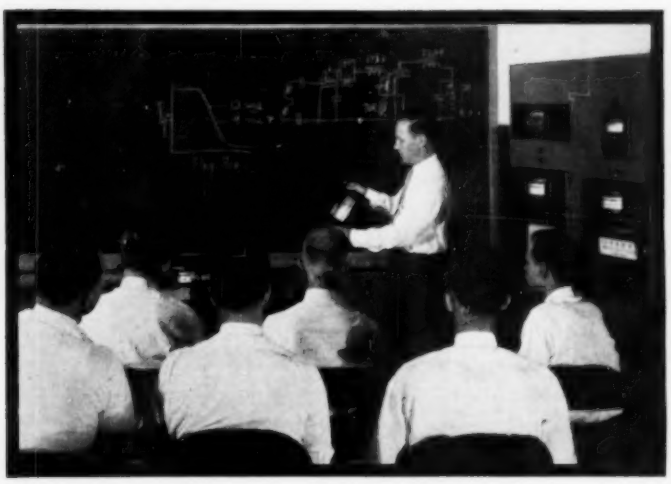
Advanced engineering and outstanding manufacturing quality are combined in Wheelco instruments, whether the job calls for recording, controlling, or indicating. The complete Wheelco line of instruments, together with unmatched experience in every type of plastic industry installation, is your assurance of satisfaction.

Here's how Wheelco will go to work for you:

Field Engineering— A complete analysis of your needs by a broadly experienced Wheelco field engineer gets your job started right. Where required by special installation problems, additional backing is provided by specialists at Wheelco's home office.

Training—Your instrument technicians and supervisors get complete information on latest design developments and maintenance procedures in regionally conducted training schools taught by Wheelco instrument engineers.

Service Centers—Production-proved designs that give you Wheelco's famous plug-in components keep maintenance needs to a minimum. Where outside maintenance is required — fully equipped, completely staffed regional service centers cut overhaul time.



Let your nearby Wheelco field engineer show you the simple way to headache-free instrumentation. Ask him for Bulletin F-6485, "Capacitrols for the Plastics Industry."

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NEWS in BRIEF

A bright future for cellulose acetate and cellulose acetate butyrate is forecasted by S. E. Palmer, of Eastman Chemical Products (see page 254). The recent introduction of cellulose propionate and the recent move of cellulosics into back-lighted outdoor advertising signs are some of the factors behind the optimistic view of the field's future outlook.

Business developments in the industry were varied in nature. Exclusive rights to its preimpregnated resin sales and processing rights in the eastern area were granted to U. S. Polymeric Chemicals by American Reinforced Plastics. Borden has consolidated its chemical operations under a new title, Borden Chemical Co. A plastic foam division has been formed by Dayton Rubber Co. The R-B-H Dispersions and Textile Colors divisions of Interchemical Corp. have been consolidated into a new Color and Chemicals Division. The equipment and inventories of Fiberglas Reinforced Plastic Molding Div., American Hard Rubber Co., have been purchased by Molded Fiber Glass Co. Monsanto's polishing plate facilities were acquired by Hawkridge Bros. Co. Nuodex has formed a new department to market its peroxide and metallic catalysts. Sandoz, Inc., bought the stock of Fine Colors Co.

Company expansions in the plastics industry continued plentiful in number. A butadiene-styrene plant that will triple its manufacturing capacity was placed in operation by Borden at Illiopolis, Ill. Celanese placed on stream its new trimethylolpropane production facility at Bishop, Tex. Colorite Plastics opened a new wing on its plant in Paterson, N. J. Dow is building a multi-million dollar linear polyethylene plant at Bay City, Mich. Eastman Chemical will expand its medium-density polyethylene plant at Longview, Tex. A new sales and administration building has been completed by Ferro Chemical at New Bedford, O. L.O.F. Glass Fibers is building a new glass fibers manufacturing plant in Corona, Calif. Minnesota Mining & Mfg. has installed new production equipment for polyester film in St. Paul, Minn. Phillip Chemical's new ethylene plant at Sweeney, Tex., has gone on stream. A new chemical pilot plant is being constructed at Melrose Park, Ill., by Richardson. Shell Chemical is building two new chemical plants at Norco, La.

New Materials to be noted (see pages 267-70): antiseptic casting material; vinyl-acrylic copolymer resin; polymerization intermediate; buffing compound with anti-static ingredient for molded parts; color fast organic pigment; epoxy tooling resins; and a sisal-filled, two-stage phenolic molding compound.

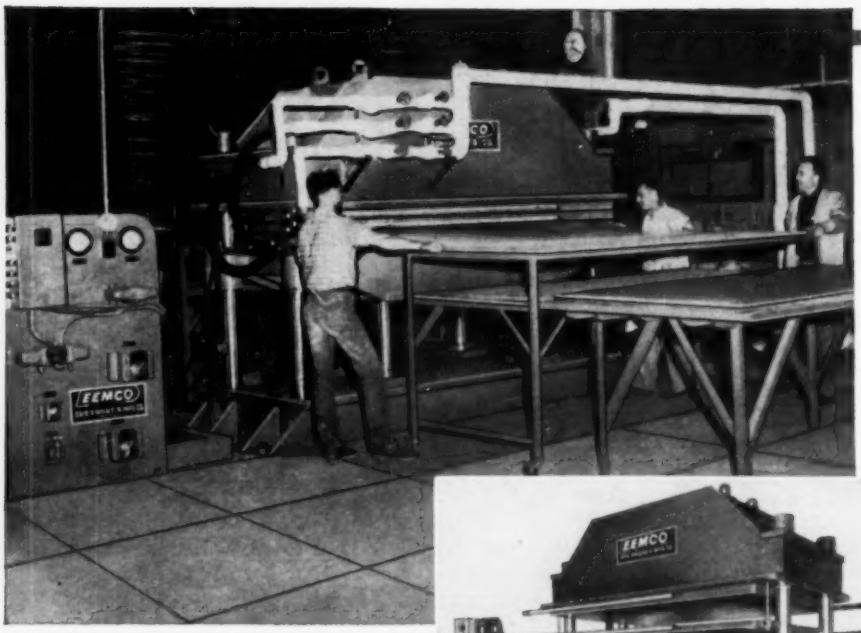
New Equipment of special interest (see pages 271-3): high-speed injection molding machine; stamping unit for instant-drying, non-smearing imprints; two-roll laboratory mill; table-model vacuum forming machine; and electronic treating unit for polyethylene.

Plastics applications worthy of mention (see pages 274-8): 75-inch wide thermoplastic sheets; gas mask with built-in spectacle frame; open-cell vinyl foam for electronic sealing to cloth or vinyl sheeting; clear wrapping film of polyethylene; flame-retardant, glass-epoxy laminate; exhaust fan with rigid PVC parts for corrosive air, fumes, and gases; absorption tower of glass-reinforced polyester; structural adhesive for aircraft and missile sandwich fabrications; combination rubber-vinyl foam upholstery material; butyrate cover for newspaper vending unit; white molded melamine chessmen; hobby horse of cast vinyl plastisol; glass-polyester appliances for play use; twist- and tangle-proof telephone cord with vinyl Jacketing; molded polyethylene sprinkling can; and decorative glass-reinforced laminates.

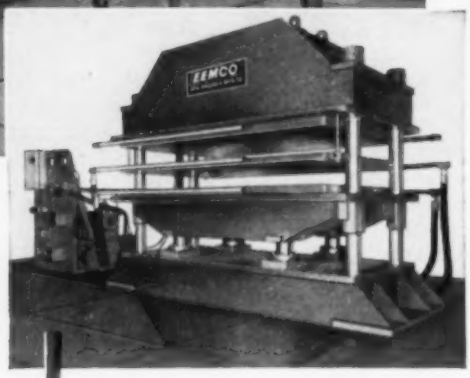
Alsynite COMPANY OF AMERICA selects

ERIE ENGINE & MFG. CO. PRESSES

to make fiberglass shatterproof window panes!



Especially designed and custom built for Alsynite, this EEMCO press was recently installed in their Portsmouth, Ohio plant. More and better production has been achieved. Automatic features have eliminated costly mistakes and greatly reduced time loss and rejects. Just as Alsynite has developed a completely new approach to industrial daylighting with their scientifically designed shatterproof window panes, so has EEMCO shown the way to increased and stabilized production and enabled them to give their customers a higher quality and more uniform product

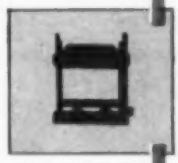


INVESTIGATE EEMCO FOR YOUR RUBBER AND PLASTICS PROCESSING NEEDS AND PROBLEMS

The competent engineering staff and experienced workmen of EEMCO are ready to help with any production problem you may have—before you buy, investigate EEMCO delivery, specifications and prices. EEMCO designs and builds a complete line of mills and hydraulic presses for the rubber, plastics, wood products, and fiberglass industries.

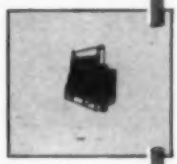
Pictured above is the 102" x 60" EEMCO 110 ton hydraulic press built for Alsynite—complete with automatic cycle controls and pressure regulators. Other EEMCO installations have achieved similar successes and helped owners toward the goal of more and better production. Why not investigate EEMCO for your hydraulic press requirements?

REINFORCED FIBERGLASS MOLDING PRESSES



DOWN OR UP ACTING PRESSES *(OPTIONAL)*

FIBERGLASS PREFORMER *(ALL SIZES)*



CURING OVENS *(ALL SIZES)*

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Designers and builders of a complete line of mills and hydraulic presses

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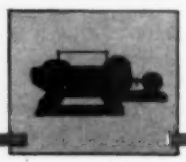
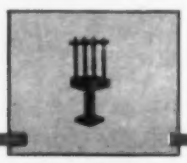


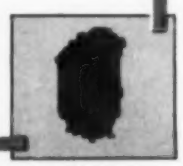
MILLS



LABORATORY PRESSES

COMPRESSION MOLDING PRESSES

TRANSFER MOLDING PRESSES



LAMINATING PRESSES

A report from Du Pont on . . .

11 formulations of ZYTEL® nylon resin

The following formulations of ZYTEL offer an extensive range of variations in such properties as melt viscosity, rigidity of final product, temperature rating, solubility in chemicals. By selecting the correct formulation, you can do a better job of coordinating end-use requirements with available fabrication techniques. All formulations offer the basic advantages of ZYTEL nylon resin: its high strength-to-weight ratio; its toughness, impact strength, abrasion resistance; its versatility with regard to production processes. Du Pont engineers will be glad to work with designers, processors and fabricators in selecting optimum compositions for specific uses.

101 Highest-melting resin with high fluidity at molding temperatures; has good machineability, high impact strength with maximum stiffness. Molded or extruded. For general-purpose moldings such as mechanical parts, consumer items.

103 Comparable to ZYTEL 101, but stabilized for extended operation at elevated temperatures. Molded or extruded. For electrical parts, coil forms, fastening devices.

105 Black composition with excellent weathering characteristics, comparable to ZYTEL 101 in general properties. Molded or extruded. For automotive parts, electrical parts, weather-resistant moldings.

42 A high-viscosity extrusion grade generally comparable to ZYTEL 101. Extruded. For tubing, film, bottles, extruded shapes.

31 Offers lower moisture absorption and greater flexibility than ZYTEL 101. Molded or extruded. For wire jacketing, special mechanical moldings.

33 Thermally stabilized extrusion grade comparable to ZYTEL 31. Molded or extruded. For wire jacketing, electrical parts.

37X Black nylon stabilized against weathering and thermal degradation offers low moisture absorption and excellent toughness. Molded or extruded. For wire jacketing, weather-resistant moldings.

211 Semi-rigid composition offering a combination of high impact strength and resilience. Molded or extruded. For impact devices and parts requiring exceptional toughness.

3606 A heat and light-stabilized flexible composition. Extruded. For wire jacketing, particularly field wire.

63 A flexible composition which is soluble in alcohol, but has good resistance to gasoline and oil. Flow characteristics are comparable to conventional thermoplastics. Molded, extruded or used in solution. For wire jacketing, sheeting, packings, seals, textile coatings.

69 A more flexible composition than ZYTEL 63, with superior resistance to impact and flexural fatigue. Molded, extruded or used in solution. For jacketing mechanical cables and ropes, and for impact devices.

• • •

All compositions are packaged as solid granular materials. Some of the types are available in colors. For details on the physical properties of these formulations and a description of many of their end uses—

WRITE TO: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 323, Du Pont Building, Wilmington 98, Delaware. In Canada: Du Pont Company of Canada (1956) Limited, P.O. Box 660, Montreal, Quebec.

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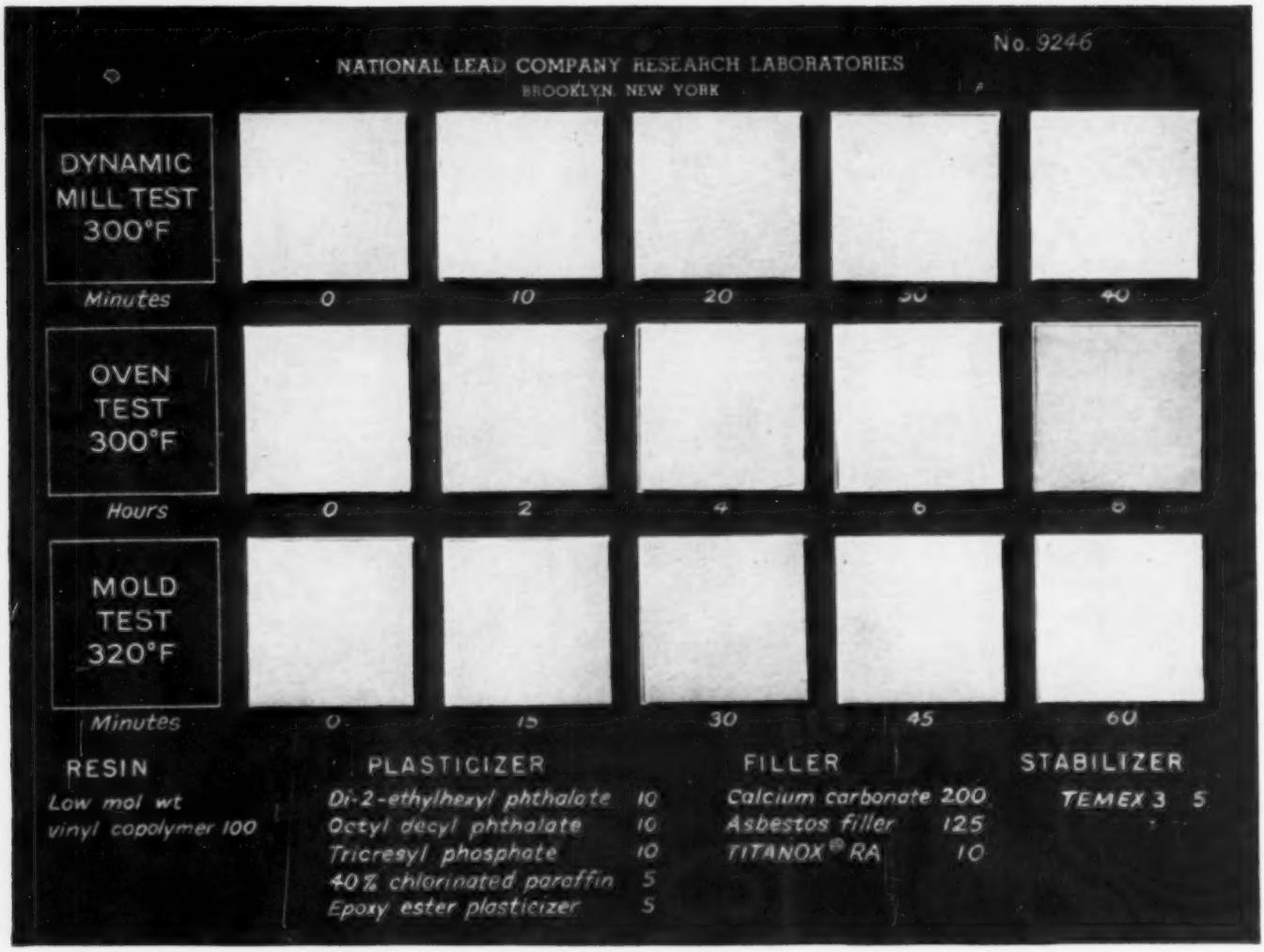

How's this for color retention?

New stabilizer..."Dutch Boy" Temex 3... gives 3-way better color control in vinyl-asbestos flooring

This test card shows what you can expect from asbestos-filled vinyl flooring stocks stabilized with the new "Dutch Boy" stabilizer . . . Temex 3.

In these stocks, this specially-developed barium-zinc compound gives you a 3-way better control over color during processing:

Best yet for heat stability

Mill, mold and oven tests are alike in demonstrating that "Dutch Boy" Temex 3 stabilizer provides greater heat stability than ever before attainable for vinyl asbestos-filled flooring.

Complete freedom from interactive color change

Temex 3 stabilizer has minimum reactivity . . . does away with pinking, bluing and other color shifts associated with interaction between stabilizer and filler impurities.

No harmful lubricity

Temex 3 stabilizer adds no lubricity to the compound. At any recommended level of stabilizer, critical color values in whites and pastels can be maintained . . . color separations kept sharp.

Steps up color life, too

Along with improved color control during processing, "Dutch Boy" stabilizer Temex 3, also assures improved color life after flooring is laid . . . preventing discoloration or staining by sulfur compounds.

Other "Dutch Boy" stabilizers meet other vinyl flooring needs . . . Tribase and Normasal®, for other loaded stocks . . . Clarite®, for homogeneous non-asbestos stocks. Still others . . . seventeen more, in fact . . . improve other vinyl products.

Seeking to improve *your* vinyl formulations? If so, look into these versatile "Dutch Boy" stabilizers. A new edition of the "Dutch Boy" Stabilizer Handbook is available. Ask for a copy.

Dutch Boy® CHEMICALS

NATIONAL LEAD COMPANY

111 Broadway, New York 6, N. Y.

In Canada: CANADIAN TITANIUM PIGMENTS LIMITED
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Jam-Packed with Flavor!

because it's packed in

MARLEX* 50

POLYETHYLENE

. . . the tempting tang can't escape!

Sterilizable MARLEX 50 *tubes* are a great new development in food packaging! No other type of material will do this job so well and so economically! Jams, syrups, sandwich spreads and other foods and drugs, formerly requiring the protection of expensive *coated* polyethylene, can now be packaged at less cost in *uncoated* sterilizable thin-wall tubes made of MARLEX 50 resin. Products have long shelf life in MARLEX 50 tubes because permeability is low at all temperatures.

"Heat'n serve" frozen food packaging is one of the most promising applications for film extruded from MARLEX 50. Flavor is sealed in, and the housewife has no pans to wash!

Chemicals, foods and drugs that would show extensive permeation with conventional polyethylene now can be economically shipped in drums or cartons lined with tougher, more impermeable MARLEX 50 polyethylene.

Marlex 50 food packaging has outstanding resistance to attack and permeation by moisture vapor, gases, chemicals and oils. Containers made of heat and cold-resistant MARLEX 50 can be steam-sterilized prior to filling...and frozen afterwards if required.

*MARLEX is a trademark for Phillips family of olefin polymers.

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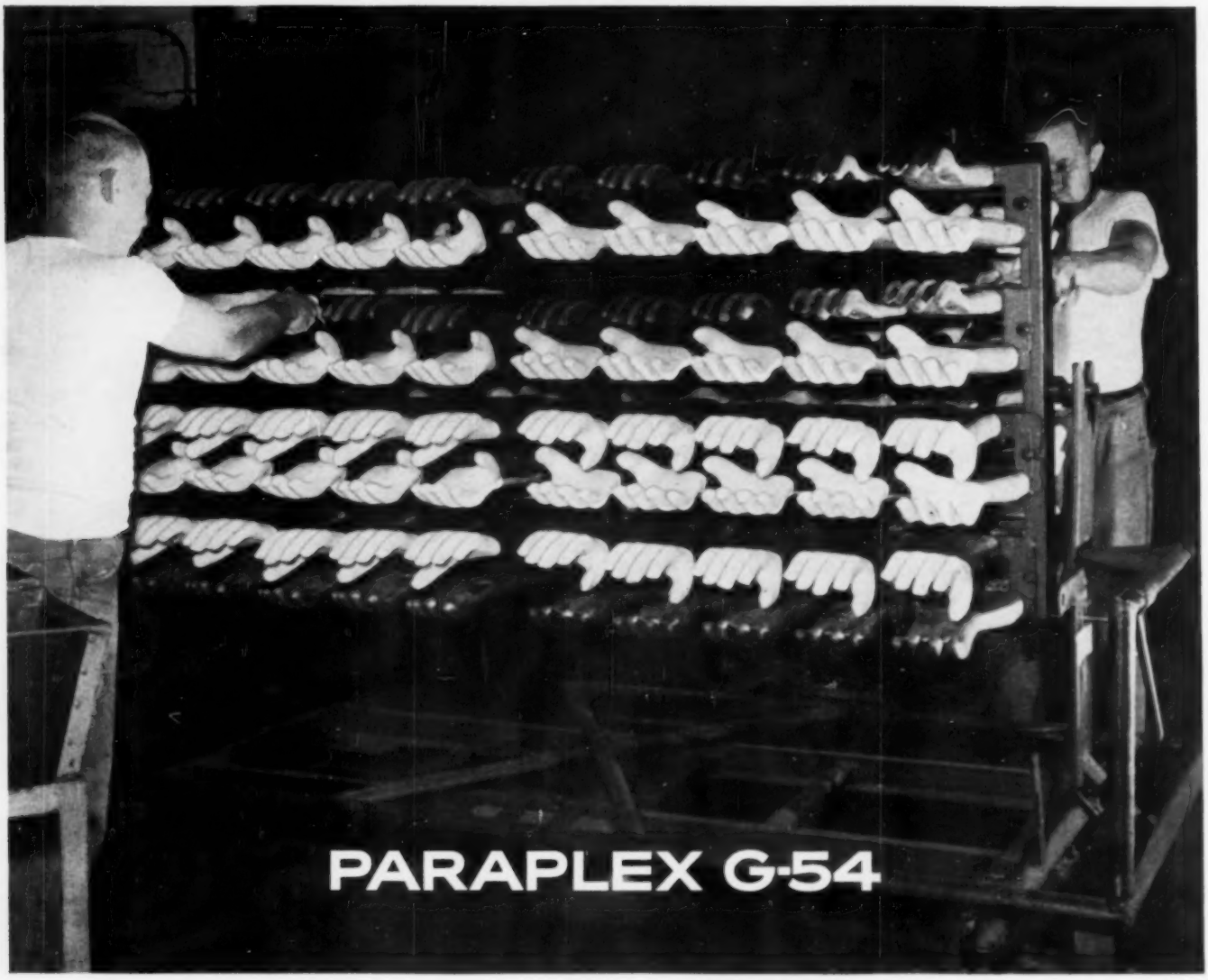

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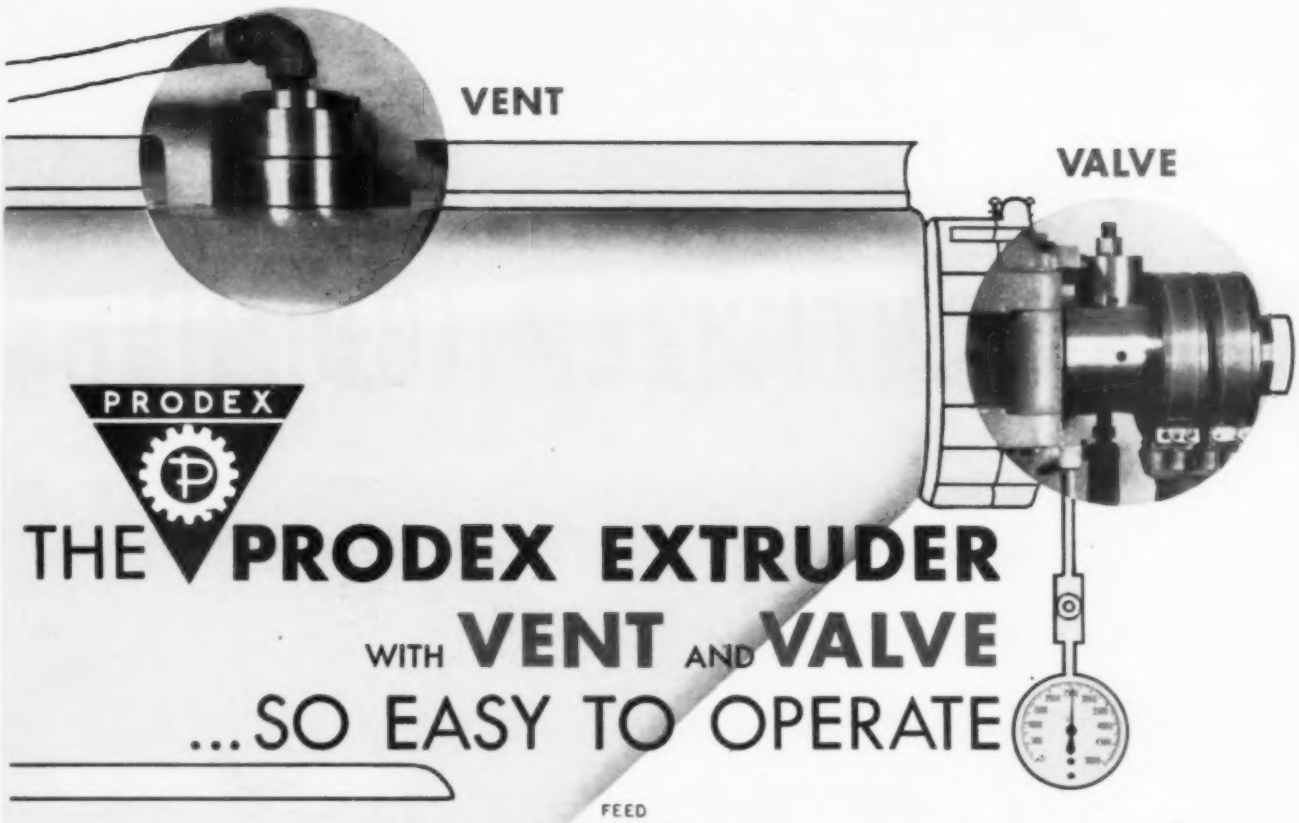

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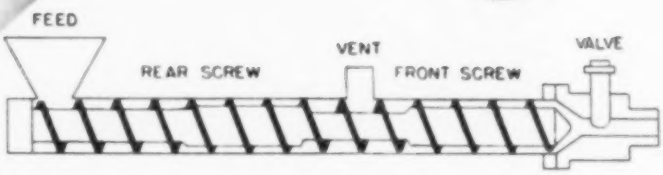

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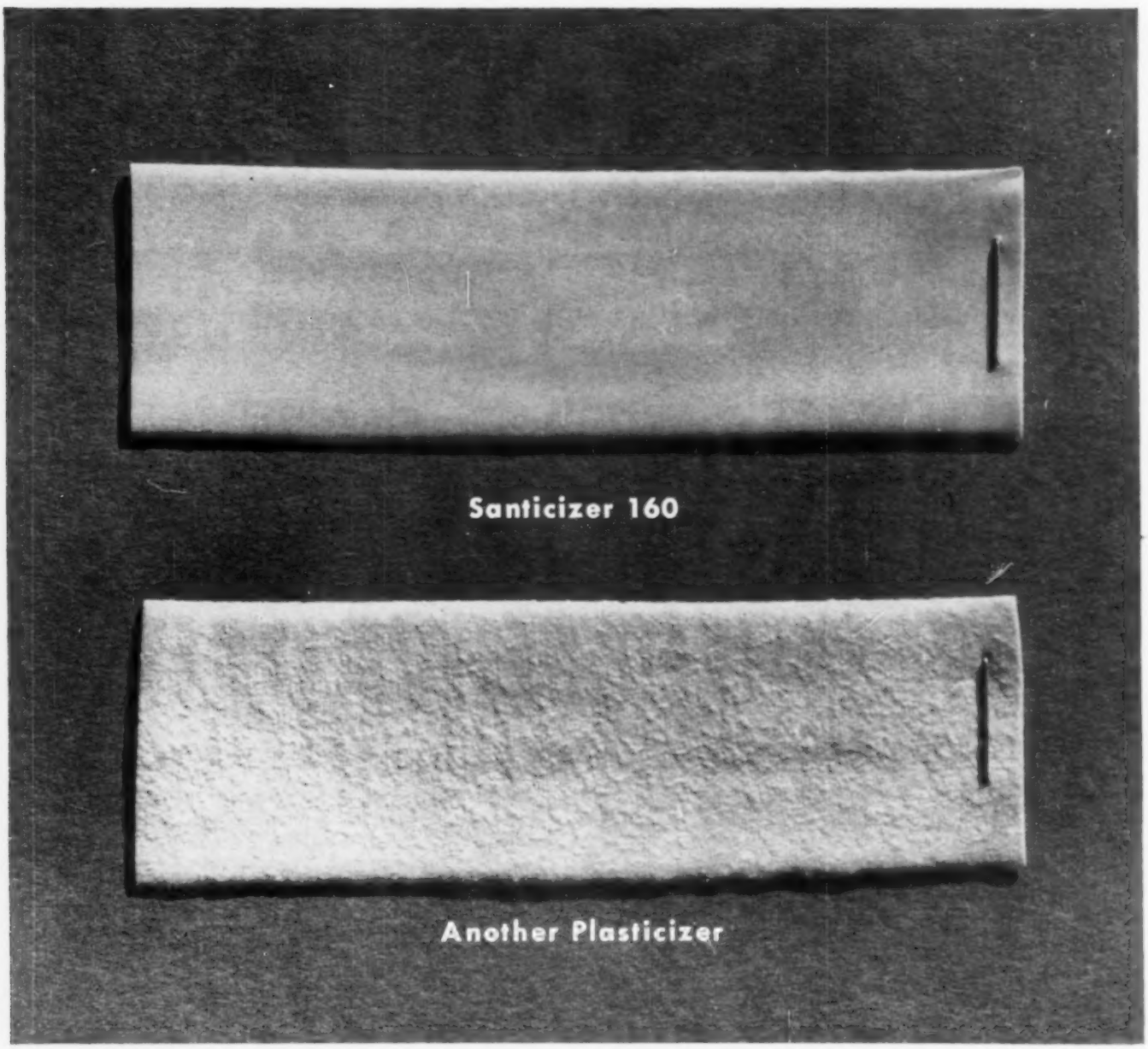

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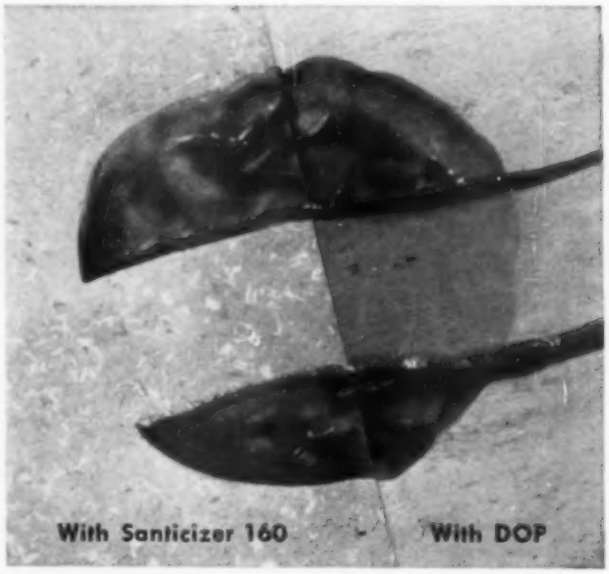

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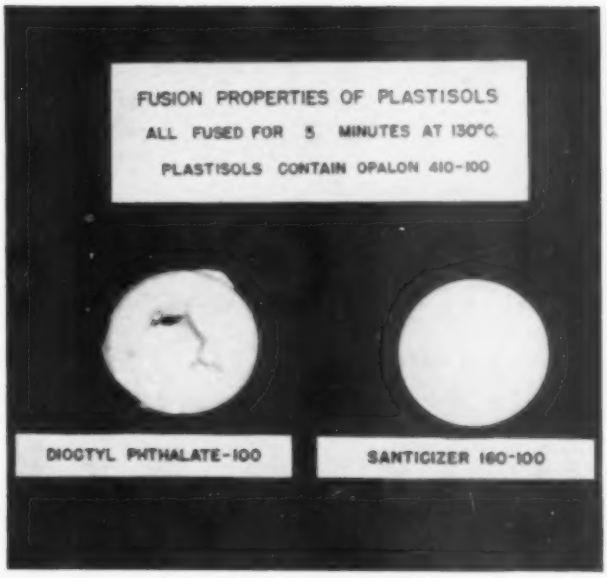

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A word about Diamond PVC *resin*

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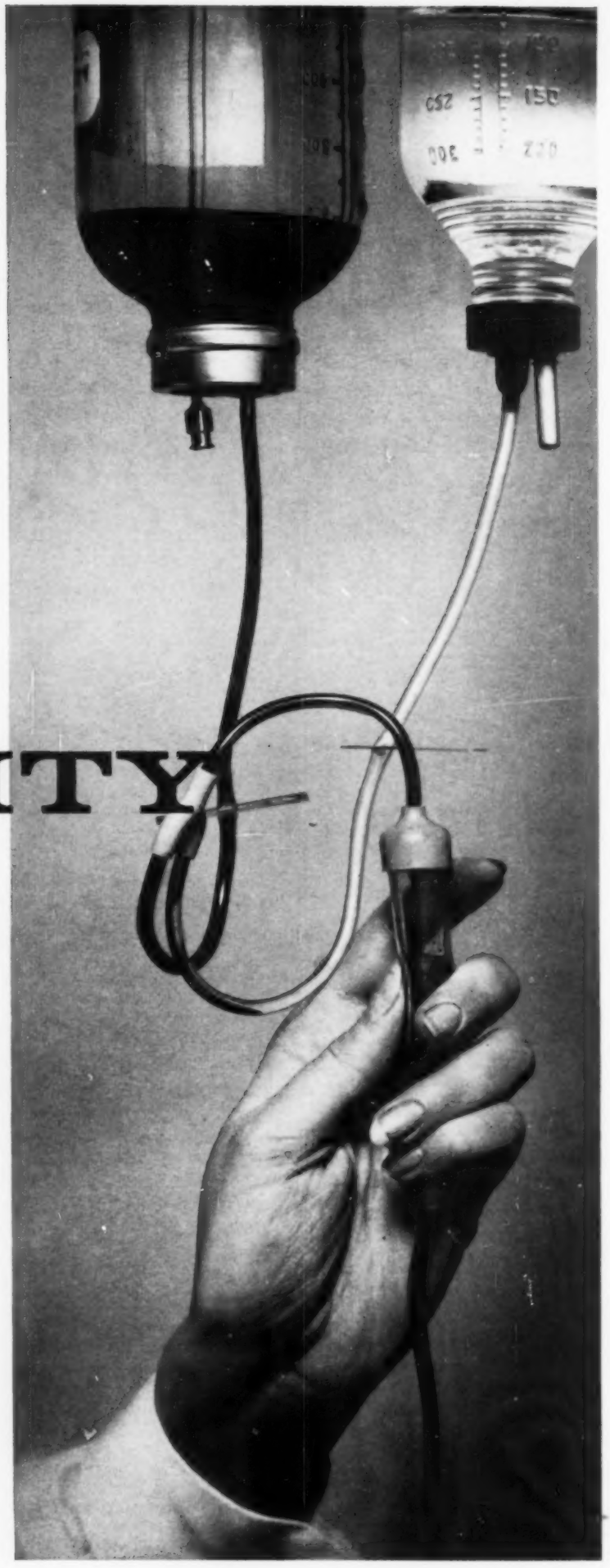

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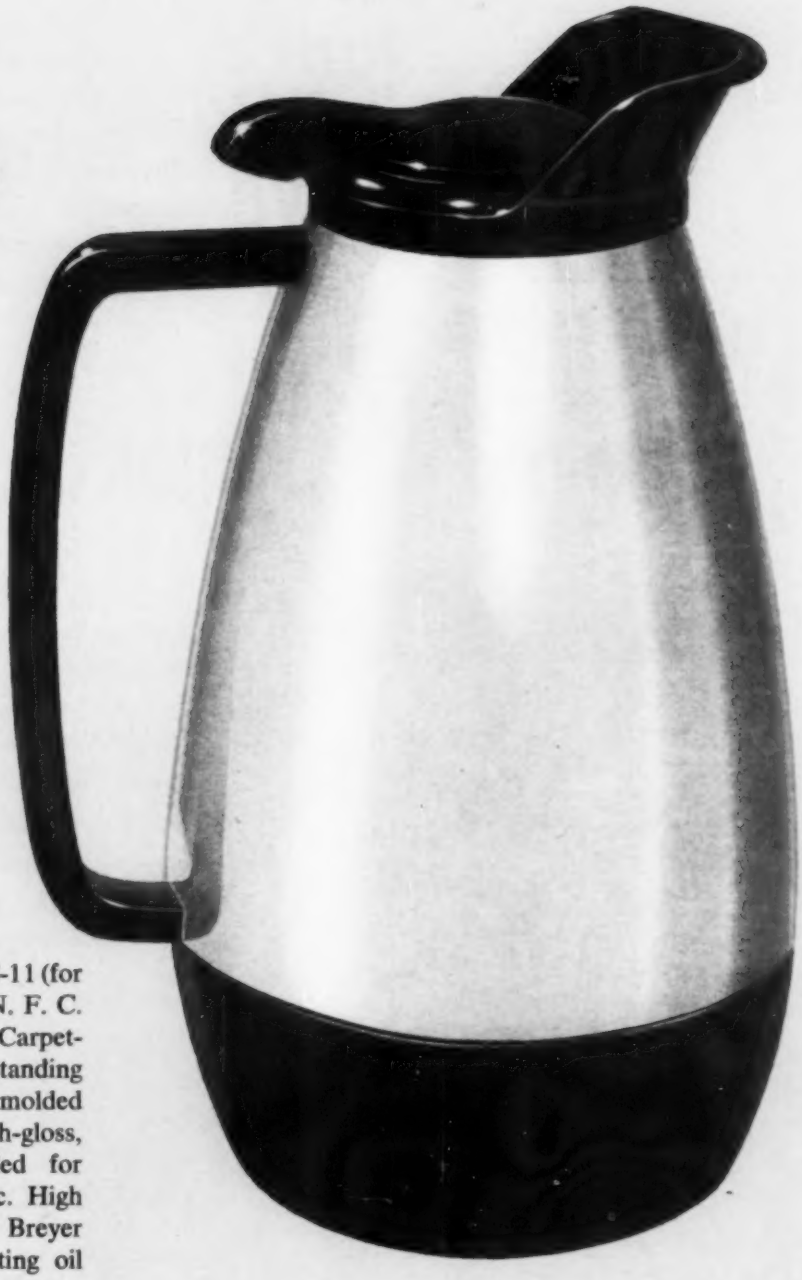

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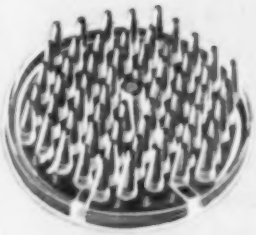

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TABLE OF PROPERTIES (RMD-4511)

Values Relating to Fabrication

Specific Gravity (D792-50)	1.07 (Varies slightly with color)
Weight per Cubic Inch (Molded) gms.	17.5
Bulk Factor (D1182-54) Diced	1.98
Pellet	1.71
Molding Shrinkage (D955-51), in./in.	0.004

Values from Mechanical Tests

Izod Impact Strength (D256-54T) ft.-lb./in. of notch	
⅛ in. thick	0.55
¼ in. thick	0.45
Tensile Strength (D638-52T), psi	12,000
Elongation in Tension (D638-52T), per cent	3.2
Flexural Strength (D790-49T), psi	17,300
Modulus of Elasticity in Flexure (D790-49T), psi	5.2×10^5

Values from Miscellaneous Tests

Heat Distortion Temp. (D648-45T) (¼ in. thick, 264 psi) deg. F.	200
Thermal Coefficient of Linear Expansion (D696-44 per deg. C.	7×10^{-5}
Water Absorption (D570-54T), per cent gain in weight in 24 hours	0.23
Rockwell Hardness (D785-51)	M83

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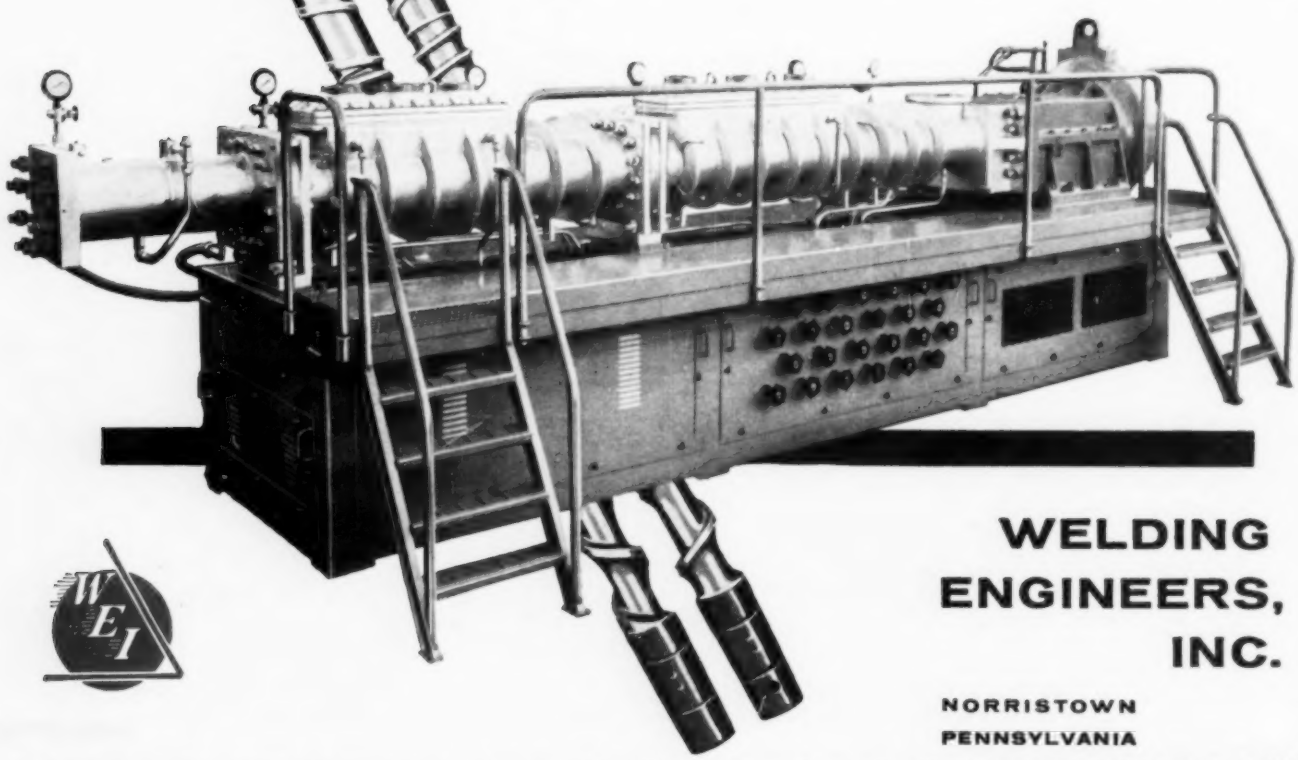

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PLASTICS TECHNOLOGY

The Thirty Years of Plastics Impact Testing—Part I

The beginning of a two-part analytical discussion of past accomplishments and the present status of impact testing, and the outlook for the future.

R. F. WESTOVER, *Member of Technical Staff,*
Polymer Mechanics Section,
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

OUT of the chaos of two centuries of investigations of impact on metals and three decades of impact applications to plastics, we can find little grounds for agreement among present-day investigators. Notched and unnotched specimens have been made in various shapes and sizes, and have been subjected to tensile, compressive, torsion, and bending impacts. Materials have been thrown, dropped, and subjected to blows from hammers, bullets, falling weights, pendulums, falling balls, horizontally moving balls and projections from flywheels. In adidtion, they have been fatigued by low-energy impacts. The impact velocities or loading

Robert F. Westover was born in Williamsport, Pa., on Sept. 20, 1924. He attended Princeton University, receiving a B.S.E. in Mechanical Engineering in 1950, and an M.S.E. in Plastics Engineering in 1952. He was a research associate at the University's Plastics Laboratory from 1950-52, and an instructor in mechanical engineering from 1952-54. Summer positions during this period include work as a plastics design engineer with North American Aviation. He joined Bell Telephone Laboratories in his current position in 1954.

He is an active member of ASME, SPE, Princeton Engineering Association, Sigma Xi and the American Ordnance Association. Mr. & Mrs. Westover have three children, and reside in Madison, N. J.

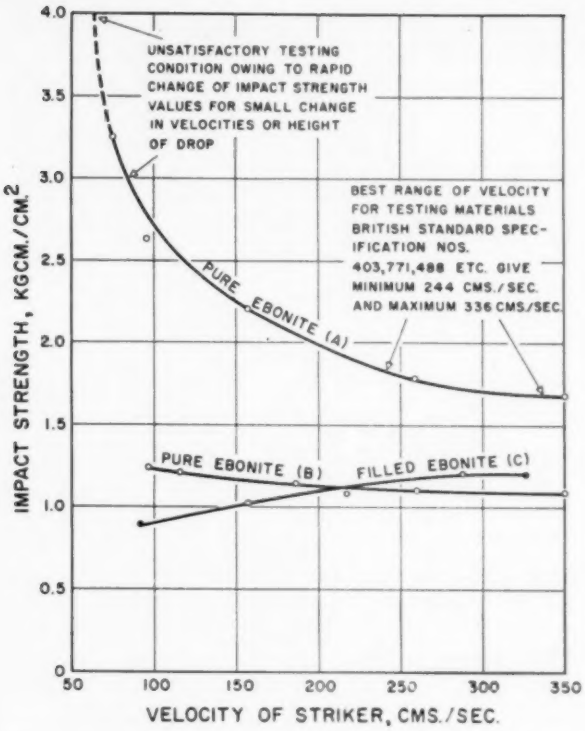

Fig. 1. Effect of striker velocity on impact strength test results with ebonites (3, 4).*

rates have varied from static conditions to 1,700 feet per second.

There are nearly as many types of testing machines and methods of testing or interpreting the impact phenomena as there are investigators. It is difficult to find agreement as to the purpose of the impact test or what it is that we should be trying to measure.

Past Accomplishments

The door to impact testing of plastics was opened in 1926 by a report by W. W. Werring (1)*. Since the turn of the century, the Izod and Charpy types of pendulum machines had been used widely in both Europe and the United States for impact testing of metals. With the application of these machines and their accompanying methods to plastics, it became apparent that certain errors inherent in the equipment and in the test methods were greatly magnified. The most significant errors were those due to broken half error or toss factor and insensitivity.

Werring's paper gave a description of Izod- and Charpy-type machines of lower energy capacity and having variable velocity and capacity. Reducing the impact capacity increases the sensitivity and reduces the broken-half error, but has the disadvantage of not maintaining a constant rate of loading. This disadvantage was not as pronounced with these machines as in some later machines of Callendar (4), Telfair and Nason (7), and Stock (14) in which the energy delivered was just enough to crack or break the specimen without the usual tossing of the broken end.

High-speed motion pictures were taken of the tossing of the broken parts of both Izod and Charpy specimens. For the Izod-type specimen, pictures were taken both during a single-blow type of test, and later after replacing the broken half to its original position. Considerable rotation was observed to have been imparted to the broken half during the breaking operation, but relatively little during re-toss. Werring was concerned with the interference to the pendulum by the broken parts of the Charpy specimens after fracture. A much cleaner follow-through was observed in the Izod test.

The effects of clamping pressure and both initial energy and velocity of the blow upon the impact results was discussed. In general, the initial energy in the pendulum had no effect on the impact strength, while the velocity effect was appreciable. The effect of clamping pressure on the impact value of Izod specimens was found to be negligible for the materials tested up to pressures greater than would be anticipated in practice.

Church and Daynes (2) presented the methods and results obtained from testing ebonite for impact by a falling weight-type tester on a Charpy-type specimen. A statistical method was developed for determining the impact strength of a material tested by the single-blow method. The impact energy is taken as the energy of the blows that produce 50% failures among a group of samples.

They performed their tests on both notched and unnotched specimens, using both single-blow and increasing-blow methods. The effect of fatigue due to this latter method was observed to give a lower value of impact strength. The impact strength for ebonite was found to be very sensitive to variations in the notch radius, but not very sensitive to variations in the depth of notch provided the depth of material above the notch remained constant. Impact strength was reported to increase slightly with velocity.

Callendar (3, 4) reported on a drop weight-type, variable capacity machine that was used for both single-blow and increasing-blow impact tests. He believed that the excess swing methods were totally unsuitable

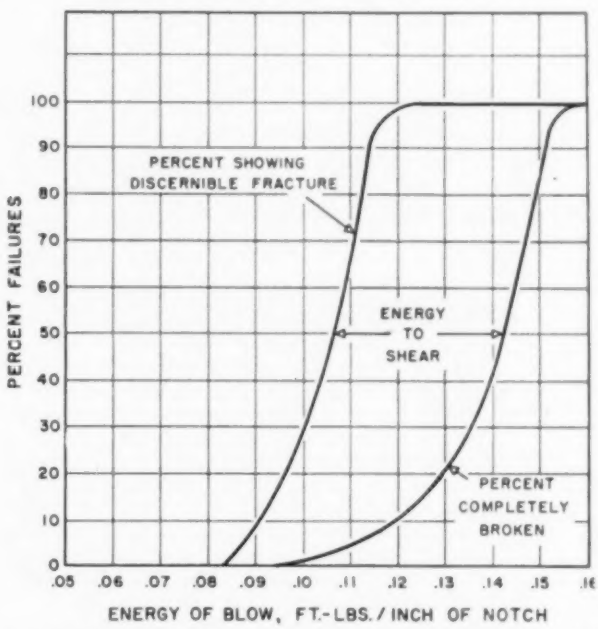

Fig. 2. Effect of energy of impact blow on percent failures for two criteria of failure (7).

*Numbers in parentheses refer to Bibliography at end of article.

because of the shearing, tearing, friction, and tossing errors. These errors were determined by subtracting the energy to just crack a standard sample of a material from the total excess swing energy for a similar sample. The Charpy-type support was used on his new machine. Callendar and others have voiced the criticism of the Izod-type support and its unsymmetrical type of loading has detrimental effects on the testing machine employed. For the pendulum-type machine, a shock component is directed radially toward the bearing and supporting structure.

The end-point of the impact test was considered to be the appearance of the first crack. This was reported to be easily detected in the repeated-blow type of test because the striker should fall dead on the following blow. Calendar also stressed the dependence of brittle or touch failure on the temperature, dimensions of the test piece, notch dimensions, and impact velocity.

Velocities between 240-340 cms. sec. were recommended because of the flattening off of the impact strength versus velocity curve in this region (see Figure 1). It was pointed out that the B.S.S. and the A.S.T.M. have chosen testing velocities within this region so that more consistent results can be obtained. The impracticality of using such impact results to rate materials for design purposes should be quite obvious. As an example, it can be seen from Figure 1 that an impact rating made at 240 cms. sec. striker velocity favors material "C" over material "B", while a rating made at 180 cms sec. favors material "B" over material "C."

Present Status

In order to correct the Izod impact value for tossing of the broken half, the broken half of the specimen was replaced and struck away again. The energy to re-toss the broken half was considered to be the tossing error. This method was employed earlier by Zinzow (5). The broken-half error for a number of materials tested was between 43% and 1,600% of the corrected impact strength values. The difficulty with this method is that the actual tossing velocity for a specimen usually differs from the velocity of a previously broken sample. The energy for rotation does not seem to have been considered in this report. Lethersich (25) reported that rotational kinetic energies as high as ¾ the value of the linear kinetic energies have been reported for broken halves during the breaking stroke.

I. L. Hopkins (6) observed in a notched Izod test on a mica-filled phenolic material that less energy was required to break and toss the specimen that was required to re-toss it. This gives a negative impact strength value for the material.

Telfair and Nason (7) separated the energy to break a plastic specimen into five components, as follows:

(1). Energy to initiate the fracture.

(2). Energy to propagate the fracture across the specimen.

(3). Energy to plastically deform the specimen.

(4). Energy to throw the broken end.

(5). Energy lost through vibration of apparatus and through friction.

They point out that the notch serves to prevent plastic deformation, thereby reducing the energy due to plastic deformation. Very early in their impact studies of plastics, Werring and others stated the belief that a negligible amount of energy was dissipated in vibrations of the apparatus. Telfair and Nason expressed the belief that the energy to crack the sample should be the criterion for failure. Through statistical methods with a rather large number of samples on a low-energy pendulum machine, they obtained results on energy to crack and energy to tear or propagate the fracture for filled phenolics and various other plastics.

Figure 2 is a plot of percent failure versus the energy of blow, taken from Telfair and Nason (7). The statistical method employed is similar to the method described by Church and Daynes (2) in which the impact value is taken as the energy of the blows that produce 50% failure. In this case, two plots were made; one uses the appearance of a crack as the criterion for failure of the specimens, while complete fracture is the criterion for the second. The energy to shear or tear the specimen is the difference in energy betwen the two plots at the 50% failure points.

The energy to toss the broken half of the Izod-type specimen was approximated in a manner similar to the method used by Callendar in which the broken-half was replaced and the energy removed from the pendulum on the re-toss was observed. The authors were aware of the inaccuracies of the assumption that the velocity of the retoss was the same as the velocity of the original toss after break. The broken-half error was calculated to be more than 100% of the impact value of the specimen.

The fatigue effect of previous blows on the impact strength of plastic materials was investigated. For most materials, there was a noticeable decrease in the single-blow impact strength if the sample had received one or more previous blows of less than fracturing magnitude. However, some materials seemed to show an effect similar to work-hardening of metals, such that the impact strength actually was greater after undergoing previous blows.

In order to obtain the energy to just crack the specimens, an Izod pendulum machine was employed in which the energy available was varied by regulating the starting height and, therefore, the impact velocity. The authors recognized that a falling weight-type machine, such as those employed by Callendar (3, 4) or Church and Daynes (2), would have been more suitable, and would have given more accurate results in that the velocity could be kept constant by varying the mass of the striker rather than the height of fall.

Hazen (8) considered the problem of relating the impact strength and toughness of plastic molding materials to the more fundamental static mechanical properties flexural strength, and modulus of elasticity. Basic elasticity theory has been extended to include approximately "plastic" materials whose load deflection curves are straight lines or nearly so. Comparisons were made between the notched Izod impact strength results and the energy to break an unnotched beam by static bending for a large number of phenolic molding materials and for plasticized cellulose acetate. This attempt to correlate impact strength with static flexural strength is based on the premise that the rate of loading has little or no effect on the energy required to produce

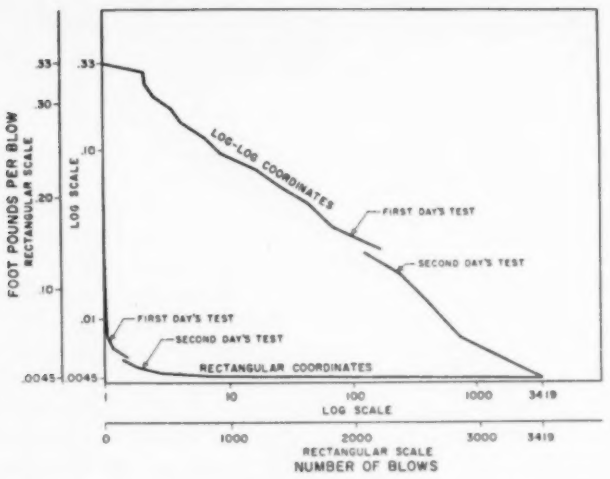

Fig. 3. Effect of energy of blow on the number of blows for failure in a repeated-blow impact test on cellulose acetate (9).

failure. Even by this time, there was considerable evidence to the contrary for plastics.

It was pointed out that the energy lost by the pendulum during an impact test is shared by the specimen and the machine in the inverse ratio of their respective elastic coefficients. The greater the modulus of elasticity of the specimen, therefore, the greater will be the proportion of the energy absorbed by the machine. This further complicates the situation with regard to design of a suitable impact machine for plastics insofar as the machine should have a fairly low capacity for good sensitivity; high capacity for a more nearly constant rate of loading; low variable capacity for cracking energy determinations; and a large mass of high modulus of elasticity in the machine components.

Hopkins (9) found in the repeated-blow impact test with steel balls on cellulose acetate that even at energies as low as 1.5% of the single-blow impact value there is no so-called fatigue limit. The log-log plot of

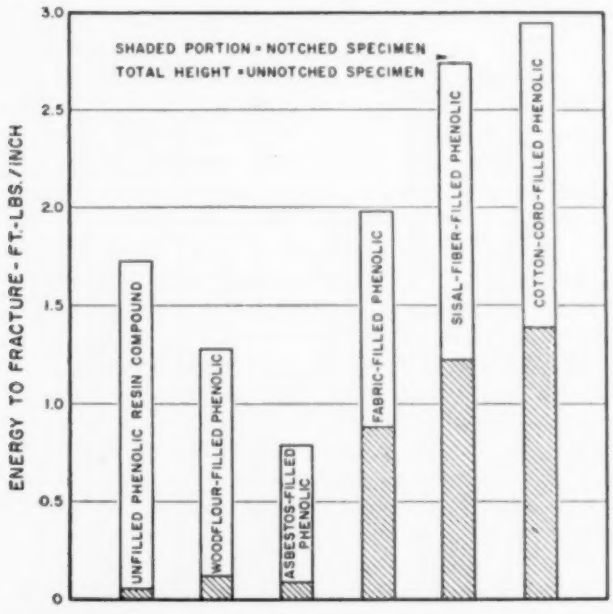

Fig. 4. Comparison of Izod impact strengths for notched and unnotched phenolic molding materials (17).

Figure 3 shows this to better advantage than does the accompanying rectangular plot. Similar results were observed for other materials, and it is believed that the high value of a fatigue energy limit, as presented by many investigators, has evolved from faulty interpretation of the plot of energy versus number of blows on rectangular co-ordinates.

An automatic drop-ball machine was employed by Findley and Hintz (10) to aid in collecting data in the study of the fatigue effect of repeated-blow impact tests on cellulose acetate for a larger number of blows than Hopkins had been able to use on the same type of material. An impact fatigue limit of less than 1% of the single-blow energy to fracture was observed. This corresponded to about one million blows to failure. The tests were continued with lighter balls out to 200-million blows to failure.

A log-log plot of stress versus number of blows gives a straight-line curve down to the fatigue limit in a manner similar to the log-log plot of energy versus number of blows obtained from the tests of Hopkins (see Figure 3). R. Burns (11) showed the repeated-blow impact strength to be a very small fraction of the single-blow impact strength for cellulose acetate butyrate. For phenolics, this ratio was one-half or less, depending on the filler employed.

A number of investigators had attempted to eliminate the broken-end error or toss factor from the impact results for plastics. Until 1943, however, no one seemed to have been able to eliminate the error with an excess swing-type test. At that time, I. L. Hopkins (12) designed and built a tensile impact, pendulum-type machine that utilized the standard base, scale, and release mechanism from the standard Izod machine. The tensile sample was held and carried by the pendulum until the motion of one end of the sample is stopped by an anvil at the bottom of the swing. The velocity at the instant of impact was 11 feet/sec.

There is no tossing of a grip or specimen end at the expense of energy delivered by the pendulum. This feature coupled with the less complex stress system of a tensile specimen has made this test a standard impact test at Bell Telephone Laboratories since 1943. Double-gated and single-gated specimens have been compared to give weldline impact data.

Lubin and Winans (13) described a drop-ball machine that was used for studies of impact strength and fatigue. This machine is capable of dropping steel balls in a rapid succession onto one end of a standard Izod test specimen. The impact strength of the plastic materials were determined by one of three methods, repeated blow method, increasing blow method and a statistical method. The criterion for failure was the appearance of the crack.

A low-capacity, single-blow, ball-type impact tester was developed by Stock (14) to fracture a standard Izod type specimen. Steel balls rolling down a chute were projected horizontally by a curved end to the chute. Carbon paper on the table beneath and beyond the horizontally-supported specimen recorded the spot where the ball landed. The residual energy of the ball could then be calculated. The energy capacity was controlled by the size of the ball to reduce the toss of the broken end to a minimum. Comparison was

made between the ASTM Izod test and the ball test results on several materials. Agreement between the results from the two methods was better at the higher impact values because of the lower toss energy for the materials whose impact energy requirements were close to the available energy of the Izod machine. A minor source of discrepancy in the comparison of results from these two methods may have been the difference in the plastic deformation at the contact area between the ball and specimen and the striker and specimen.

Morey (16) emphasized the importance of obtaining a stress-strain or load-deflection diagram during the impact loading of plastics. He summarized some optical, electrical, and mechanical devices used by people in the metals industry for obtaining such diagrams. However, the inertia forces involved in most of this type of equipment are of a magnitude too much akin to the forces applied to the specimen itself to be applied to plastics for the rates of loading that are required for a somewhat complete investigation.

The effect of heterogeneity in bonding of polymers upon rupturing, and the reforming of secondary bonds to produce plastic flow was discussed. The effects of velocity, temperature, test apparatus, notching, surface finish, humidity plasticizers shock waves and processing conditions were discussed and were in agreement with most of the investigators in the impact field at least insofar as effect is concerned.

Morey reminded his contemporaries that the conventional Izod and Charpy impact testing machines were not intended by their originators to furnish an all-inclusive impact parameter. The results of tests from one of these machines on a certain material give testimony only to that material's response to a specific set of conditions, and to none other. As far as application work is concerned, it is of scarcely greater use than a static test, since it, too, is usually concerned with only one rate of straining on one type of sample.

Telfair and Nason (17) showed that impact results for specimens notched at 13 different laboratories can differ from one another by close to a factor of two. They also have shown that the impact strength of a fabric-filed phenolic molding material varies directly with the logarithm of the velocity.

The authors stated that the common belief that impact strength decreases with velocity stems from the fact that unnotched specimens are used for static tests while notched specimens most often are used for impact tests. A comparison of the notched and unnotched Izod impact strengths for several phenolic materials, taken from Telfair and Nason (17), is shown in Figure 4.

A bombshell was dropped on the impact camp by Welch and Quackenbos (18) with their revelations on the percentage of observed energy that they had calculated to be lost to the test machine in the pendulum-type test machines. They reported that only 10-50% of the expended pendulum energy is absorbed by the specimen. The remainder was reported to be lost in the machine, and in the tossing of the broken parts of the specimen.

These authors, in reporting on phenolic molding materials, have assumed that the modulus for impact loading is the same as the dynamic modulus calculated from the natural frequency of vibrations, and is constant as in the case of static loading for phenolics. Also, that the impact deflection curve was the same as the static deflection curve. On the basis of these assumptions and the measured strain of the impact specimens, the stress was calculated.

In the discussion following a later article (29), Adams and Telfair challenged the feasibility of using the strain energy formula that was based upon assumptions that were not valid in their particular application. In rebuttal, Quackenbos, Hill, and Staff (29) recognized the weakness of the earlier paper, but modified their figures only slightly.

Very little theoretical work has been done on the bending of plastic materials under impact loads due to the complexity of the situation, but Lee in a paper on the impact of a mass striking an elastic beam (19) showed that the deflection curve of a beam under impact deviates widely from the static deflection curve. This development should cast a blanket of doubt on any analysis of impact (plastic impact, in particular) that is based upon formulas or assumptions derived from static relations.

In a later article on the effects of plastic-wave propagation in high-speed testing, Lee and Wolf (20) stated, "A material test carried out at high speed may be markedly influenced by plastic wave propagation effects. In such a case, a variation of strain occurs along the test specimen, and the stress-strain relation cannot be determined from measurements made on the specimen as a whole. If average values are taken, it is shown that a spurious strain-rate influence will be deduced when propagation effects first begin to appear as the testing speed is increased. The effect is due not to a true material strain rate dependence, but to the appearance of strain variations along the spe-

(*Continued on page 230*)

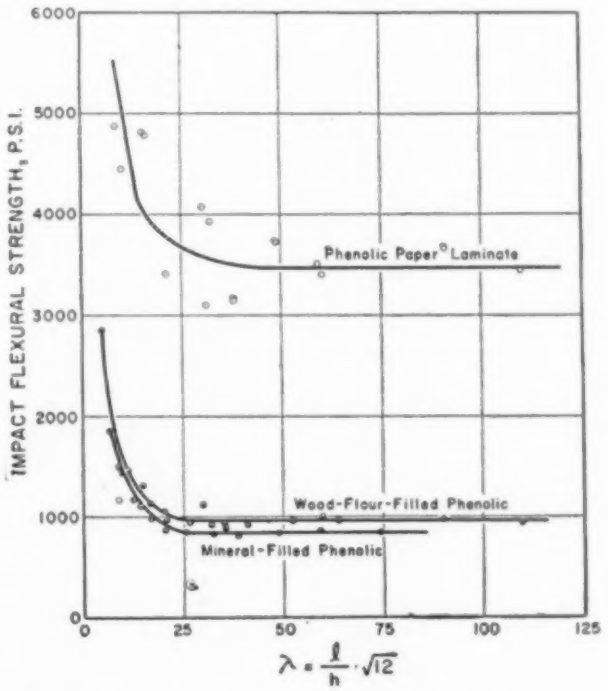

Fig. 5. Effect of specimen slenderness ratio on the impact flexural strengths of phenolic materials (24).

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Arc Resistance of Epoxies

Test results show importance and effect of fillers

on arc resistance values for resin-hardener castings.

ARC resistance measurements on plastics materials provide useful criteria for evaluating surface characteristics significant to many electrical applications. As a measuring technique, arc resistance has not been used extensively because of the unavailability of useful apparatus that met the requirements of the latest A.S.T.M. standards. Now that this situation has been rectified through the availability of practical laboratory apparatus, greater attention will be given to this practical tool.

Epoxy resins, the subject of many new and valuable applications within the electronic industry, show a marked dependence in their arc resistance values, based upon the fillers employed in the manufacture of the compounds. As a group, the epoxy resins compare favorably with other types of plastics. They possess not only an innate resistance to arc tracking, but as a thermosetting material this quality is demonstratable over a broad range of temperatures.

The apparatus employed in the measurements is the precision arc resistance testing device of the Delsen Corporation (see Figure 1). Following the methods of A.S.T.M. D495-48T, specimens are placed between the electrodes, and the arc interrupted at the exact time intervals and current densities called for in the specification, as shown in Table 1.

At the time of failure, a suitable circuit-breaking device shuts off the apparatus. Observations are made readily during the progress of tests, through a transparent acrylic hood covering the electrode assembly.

Test Procedure

To demonstrate the efficacy of the arc resistance measurements, castings were prepared from an epoxy resin and various fillers in different proportions, yielding data that have been valuable to the preparation of materials of optimum arc resistance. The casting resin employed involves a proprietary resin and hardener used for the manufacture of large castings of electrical components, without concern for material thickness or excessive exothermic temperature rise. A large transformer bushing concerned with high voltages and arc resistance is shown in Figure 2. This was cast from an epoxy resin (Epocast 10F/D-40 Hardener). The importance of good arc resistance in the materials of construction in high-voltage apparatus is well known.

Among the specific combinations employed in the study of arc resistance were the following:

(A). Unfilled epoxy resin (Epocast 202), plus Hardener D-40.

(B). Material A, plus varying amounts of 325-mesh silica.

(C). Material A, plus varying amounts of 325-mesh mica.

(D). Material A, plus varying amounts of 300-mesh aluminum oxide.

(E). Material A, plus varying amounts of 300-mesh calcium sulfate hemihydrate.

In order to reduce material variables to a minimum, the same resin and hardener base was used in all cases,

Table 1. Sequence of One-Minute Current Steps

Step	Current, ma.	Time Cycle	Approx. Rate of Heat Generation, w.	Total Time, Sec.
1/8-10	10	1/4 sec. on, 1 3/4 sec. off	3	60
1/4-10	10	1/4 sec. on, 3/4 sec. off	6	120
1/2-10	10	1/4 sec. on, 1/4 sec. off	12	180
10	10	continuous	24	240
20	20	continuous	34	300
30	30	continuous	45	360
40	40	continuous	56	420

and all specimens were cured simultaneously overnight at 165° F., and post-cured for two hours at 200° F. Specimens were ½-inch thick and six by four inches in size.

Test Results

Figures 3 and 4 summarize the arc resistance test results. Considerable differences in results exist between the top-surface area (Figure 3) and the bottom-surface area (Figure 4) of the test specimens. It is surmised that there is appreciable settling of the filler during cure, leading to higher arc resistance values on the bottom surfaces. As the proportion of filler increases, there is less difference between the bottom and the top surfaces in arc resistance. All readings represent an average of at least three tests. For comparison purposes, Table 2 also summarizes the results:

It is noteworthy that the difference in arc resistance between the top and bottom surfaces is an indication of the amount of settling of the filler. As Table 2 suggests, the silica settles the least, and is followed, in turn, by gypsum, etc. Design-wise it calls to mind the desirability of positioning surfaces to be the most arc resistance in the areas where maximum benefit from

Table 2. Arc Resistance Characteristics of Epocast 202/D-40 Resin-Hardener Combinations.

Filler	Arc Resistance, Seconds, by Method D495-48T	
	On Top Surface	On Bottom Surface
None	64	64
100% Silica	124	147
100% Gypsum	102	116
75% Mica*	79	138
100% Aluminum oxide	78	185

*Maximum amount that could be compounded and poured conveniently.

"filler settling" can be derived. Of course properly compounded materials by experienced resin formulators are the optimum approach.

There are numerous other variables of arc resistance that can be measured by the Delsen apparatus. Aside from serving as a useful quality control on cast and laminated sheets, arc resistance tests are valuable in demonstrating surface changes taking place upon aging, or due to temperature, atmospheric humidity, and pressure. As an illustration, the arc resistance

Fig. 1. Delsen precision device for determining arc resistance.

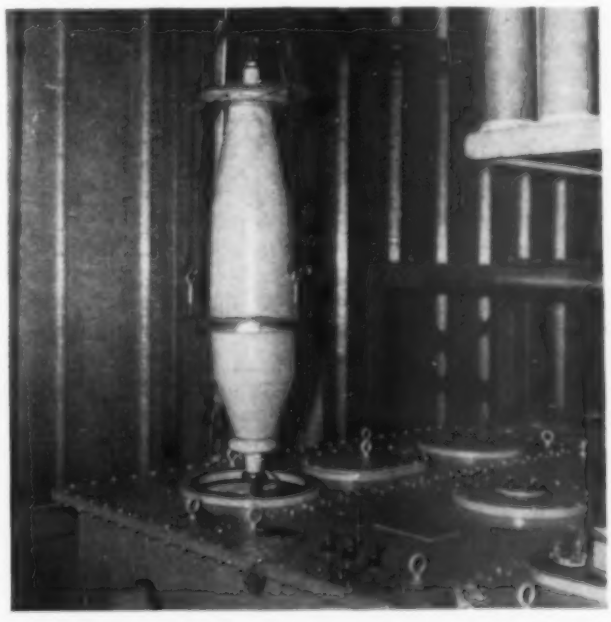

Fig. 2. Large transformer bushing of cast epoxy resin and hardener requires arc resistance in high-voltage applications as cable-to-oil and cable-to-air terminations.

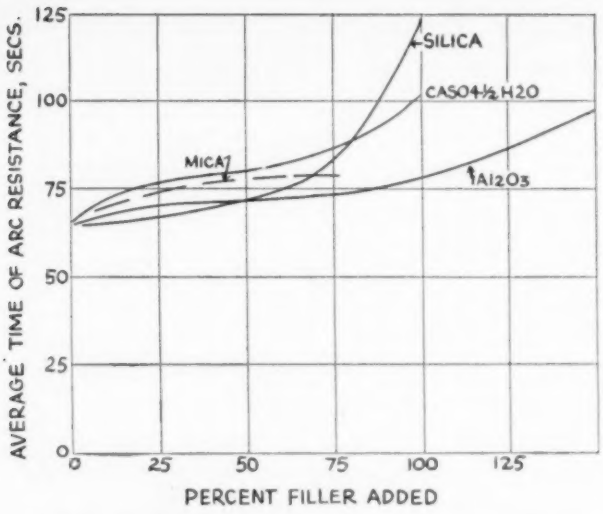

Fig. 3. Effect of filler type and concentration on arc resistance values for top surfaces of cast epoxy test specimens.

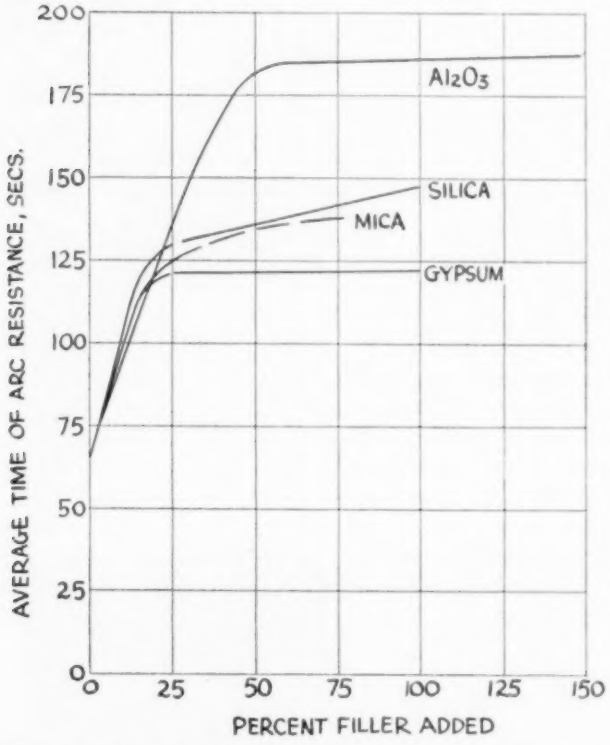

Fig. 4. Effect of filler type and concentration on arc resistance values for bottom surfaces of cast epoxy test specimens.

characteristics of a high temperature epoxy laminated example are shown in Figure 5 after prolonged exposures to high temperatures.

Conclusions

Arc resistance measurements are becoming more and more useful in the study and analysis of plastics materials, yielding information valuable for design and manufacture. The availability of reliable measuring apparatus does much to augment this phase of research.

Our test shows the effects of various fillers on arc-resistance values of specimens of Epocast 202 with Hardener D-40. In addition, differences in values between top and bottom surfaces of the cast specimens

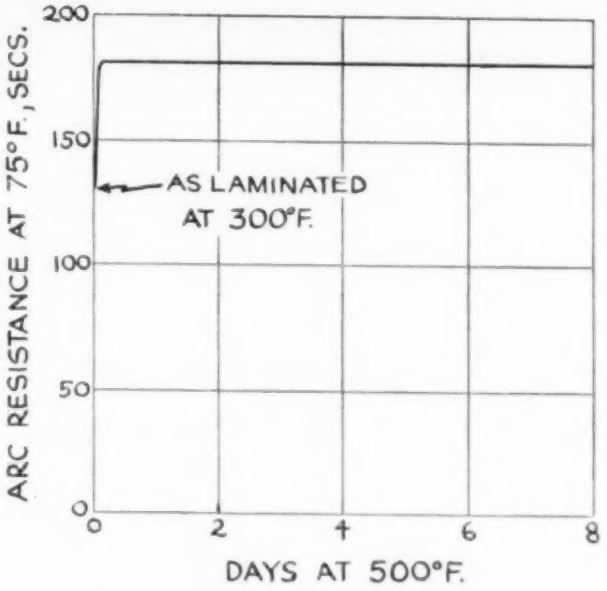

Fig. 5. Effect of post-cure time and temperature on arc resistance values for Epocast 17 high-temperature epoxy resin laminate.

indicate a degree of "filler settling" that affects arc resistance, and emphasizes the need for product design that will achieve maximum benefit of the filler settling in product areas where maximum arc resistance is required.

—THE END

The Thirty Years of Plastic Impact Testing—Part I.
(Cont'd. from page 240)

cimen, and its magnitude depends upon the dynamics of the whole test arrangement."

Sir Geoffrey Taylor (21) in his lecture on high-speed loading of tensile specimens stated, "In the case of plastics, where the memory which the material has for its past strain-history is important, a start has been made, but much more work is necessary before any real understanding of such complex phenomena is likely to be attained." Not until the relatively simple case of tensile impact on plastics is understood can we hope to investigate their stress-strain behavior in flexure.

Charlton and Farmer (23) reported on a compression-impact test for plastics wherein a cylindrical specimen is compressed rapidly between two steel cylindrical surfaces whose axes are parallel to each other, but perpendicular to the axis of the specimen. A crack was considered as the criterion for failure in this test.

The impact energy was supplied by dropping one of the two anvils down a tube from a known height. The authors reported that a linear relationship appears to exist between the cross-sectional area of the specimen and the compressive impact strength. Statistical methods were employed on the results from a relatively large number of samples to obtain the impact value for a material. No theoretical analysis has been presented for what takes place internally for this type of impact.

(Continued on page 240)

Guest Editorial

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and
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Plastics Education in Action

I was prompted to write this Guest Editorial by Editor Merrill's September 1957 editorial entitled, "Training and Educating Plastics Manpower." It was written both to comfort those among us who may have felt that the editorial implied that nothing has yet been done about the problems raised, and also to illustrate what can and has been done.

Those of us engaged in the processing branches of the plastics industry have long been aware of the shortage of men formally trained in the "practical" end of plastics. The reasons for this shortage were obvious: the current engineering curricula provided nothing more than a smattering of plastics processing, and courses dealing with plastics molding for a non-degree student, aside from some mold-design courses, were simply non-existent.

One of the prime objectives of the Society of Plastics Engineers is to foster the establishment of Plastics Engineering curricula in universities throughout the country. Though great strides have been made in this direction, it will certainly be many years before a bumper crop of Plastics Engineers, sufficient to meet the needs of our ever-growing industry, will be available. Obviously, some stop-gap measure was needed until this ultimate goal could be achieved.

In 1952, the SPE Newark Section formed an Education Committee to study this problem and to see what could be done to fill the vacuum. The committee decided that the interests of the industry would best be served by making available, as quickly as possible, a group of technicians adequately trained in the basic molding processes. By the end of 1954, concrete plans were made for supplying this training.

The faculty of the Newark College of Engineering was contacted and, with the enthusiastic support of the college, evening courses in Injection and Compression Molding were offered in the Special Courses Division for the first time in January of 1955. So great was the response, that three separate sections were required in each of the two courses.

Encouraged by these results, which showed beyond question that a definite need was being filled, the Education Committee swept on with the momentum with which it began and, in less than a year, a full Certificate Program in Plastics Engineering Technology was launched at N.C.E. Today, this Certificate Program is a going entity offering no less than 10 plastics courses, of which only two have not yet been given for the first time.

Starting with a course entitled "Process Properties of Plastics," which defines and categorizes the various plastic materials, and explains their behavior in the molding processes, the student goes on to take courses in Injection and Compression Molding, Extrusion, Mold Design, Auxiliary Tooling, Product Design, Testing and Control of Plastic Properties, and ends the sequence with two advanced lecture courses dealing with special-

(Continued on page 250)

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Cutting Production Costs and Time with Epoxy Resin Press Dies

Step-by-step operations in making dies for press forming of aluminum sheet to make aircraft parts are explained and discussed.

RECENT advances in the application of epoxy resins to making of metal-working tools have proved to be especially valuable to the aircraft industry. Aircraft production runs may be notoriously short, and often are complicated by frequent design changes. Under such circumstances, tooling becomes a large and prominent factor in the cost and time of going into production. Epoxies, among all the other tooling plastics, have saved both material costs and labor at our company. Tools are being produced in less time, for less money, and with less labor. Yet these epoxy tools still provide the high degree of accuracy demanded here at Grumman for forming and assembling operations on both military and civilian aircraft, including the recently announced Design 159 twin-engined turboprop aircraft for executive or business flying.

Investigation has shown that of the available plastics, epoxy resins have the most favorable characteristics for use as press dies. Epoxies are versatile, being available in a variety of types, and with a variety of fillers and curing agents. They have high dimensional stability that persists under varied conditions. Epoxies have the lowest shrinkage during both curing and storage, assuring excellent dimensional accuracy, a factor of prime importance in aircraft tooling.

The cured materials have high strength; the compressive strength of epoxy castings is about 20,000 psi. at yield. The tensile strength of epoxy laminates is about half that of mild steel. Fabrication can be completed at room temperatures without pressure, a definite saving in time and equipment. If a die is damaged, it is repaired easily by using some of the epoxy compound as a patching material.

Quite a number of the press dies made at Grumman have been composed of epoxy resin-glass cloth laminates. The result has been light, dimensionally stable, extremely tough tools that have given negligible production line problems. The resins used have shown good wetting characteristics and excellent adhesion to the laminating materials.

Why Epoxy Dies?

Before adopting epoxy resins for some of its press dies, Grumman commonly employed phenolics. Experience showed these phenolic materials to be more difficult to apply and, in most cases, more time-consuming to produce. These phenolics required an oven cure, otherwise considerable shrinkage would result. The chemically-induced exotherm for room-temperature curing may be non-uniform, resulting in excessive strain within the casting. In some instances, this could cause warping or cracking. In addition, the hardness of the die cannot be varied by using flexicizers, as can be done with epoxies.

Epoxies have been used at Grumman in metal-working operations other than press dies. These materials have shown themselves to be useful in making stretch dies for Hufford presses, and for forming operations in Verson presses. They also have been used for drilling and checking jigs and fixtures. In almost every instance, these tools have been equal, if not superior, to the more conventional types employed previously.

Epoxy resins normally are supplied by the manufacturer as a two-component system; resin and catalyst or hardener. After proper proportioning of the two components, hardening of the epoxy is caused by polymerization through an exothermic reaction. Different hardeners give varying curing times, some acting more quickly than others. The faster the cure, the higher the exothermic temperature created by the reaction. The quantity and type of hardener also affect the amount of shrinkage and some of the physical properties of the cured resin.

Making the Dies

The accompanying photos show some operations in the production of a three-foot by six-foot four-inch epoxy die for use on a 2,500-ton Lake Erie press in forming aluminum sheet. Two types of epoxy compounds were used in the production of this die; a silica-filled surface coat, and an aluminum-filled casting compound.

In Figure 1 are seen two similar plaster splashes taken from the mock-up of the aircraft in production. The construction of these reverse impressions shows that they are made for strength and ease of handling. A parting agent is wiped onto the splashes to allow for easy separation of the cured die, without interfering in any way with the fidelity of the resultant impression.

Figure 2 shows the surface coat being applied by brush to the splash. This coat is applied about 0.005-0.010 inch thick to provide a smooth, abrasive resistant, bubble-free surface that is hard and tough. Experience has shown that these hard coats allow easier parting, as well as superior metal-working capabilities.

Following this initial coat, six layers of glass cloth were applied to the die, using an epoxy laminating compound. Laminating procedures were used in the production of this die to give it added strength. Eliminating lamination cuts about one-third of the production time needed to make a die such as the one photographed. Subsequent dies have been made omitting the laminations, and complete satisfaction resulted. Figure

Fig. 1. Two identical splashes taken from an aircraft mock-up. Upper splash is inverted to show construction of the base.

Fig. 2. Applying silica-filled epoxy surface coat by brushing. This material is sufficiently thixotropic so that it will not run or sag when applied properly.

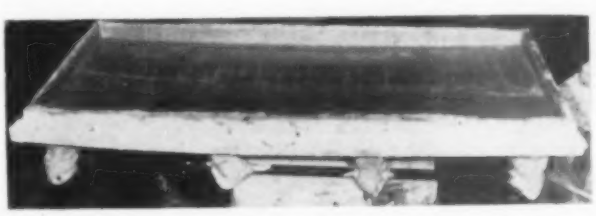

Fig. 3. Building the die using six layers of glass cloth laid up with surface coat epoxy compound.

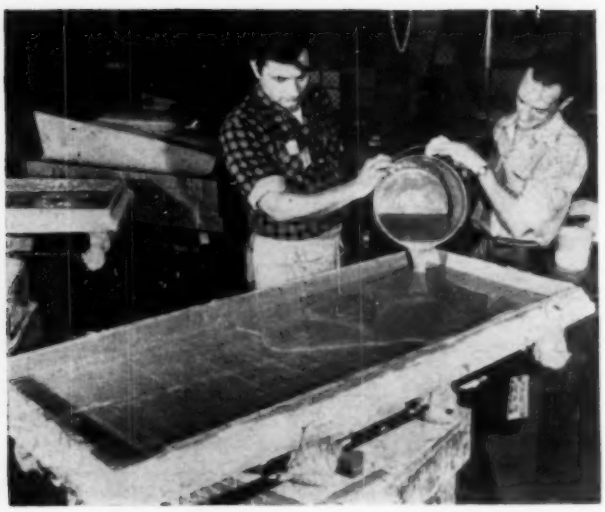

Fig. 4. Pouring first batch of Metalset A3 epoxy casting compound into die-building mold.

Fig. 5. Making the final pour of epoxy casting compound into mold with back-up plate in place.

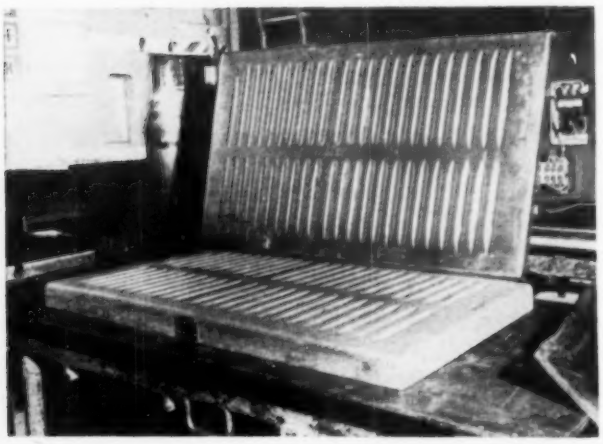

Fig. 6. Finished laminated-epoxy press die with a piece of formed aluminum sheet (above).

3 shows the lamination procedure completed and the die awaiting the first pour of the aluminum-filled epoxy casting compound.

Pouring of the first batch of Metalset A3 epoxy casting compound, product of Smooth-On Manufacturing Co., Jersey City, N. J., is seen in Figure 4. The epoxy compound is mixed with the curing agent in relatively small batches to eliminate waste. The mixture is poured into one corner of the mold and allowed to flow away from this corner to eliminate bubble formation. Pouring is done before the lamination has cured beyond the point where a good bond can be obtained between the laminate and cast areas. After the last pour, the back up plate is positioned.

The back up plate, seen in Figure 5, is a one-inch thick piece of masonite, and is incorporated to add rigidity and stability to the die. (It should be noted that several subsequent dies were made without this back up plate, and the results also were satisfactory.) The masonite plate is held in position by three boards fastened to its back and extending beyond the lips of the splash. The masonite plate is cut back approximately ½-inch from the inside surface of the splash, except at one end to allow for the epoxy casting compound. This casting compound is poured until it comes up the side of the masonite equal to the back surface, and also through the bored holes in the plate that are provided for greater anchorage of the cured compound. A wooden paddle, being held by the technician seen standing by in Figure 5, can be used to level down any excess resin.

When the epoxy has hardened and is taken from the mold, the cross boards on the masonite are removed, and the entire die is inverted on an ⅛-¼ inch layer of epoxy poured on a surface plate; the surface plate being previously protected with a parting agent. This procedure, which is not shown, gives an absolutely flat surface on the back of the die, assuring uniform contact with the press bed and eliminating excessive or critical stresses in the die during production.

Figure 6 shows the completed and trimmed die, and an aluminum piece formed on the die with a Lake Erie press. The 0.032-inch thick sheet aluminum was formed by mating the epoxy die with a 10-inch thick crude rubber pad. The finished piece shown will eventually find its way into the fuselage of a cargo-type aircraft.

Production of this die by our Tooling and Methods Department took approximately 1½ days of labor, or about 30 hours of total time for the two men involved. As mentioned before, this time could have been cut one-third by elimination of the laminating procedure. Any future modification of this piece, as well as repairs of small surface damages from improper handling, can be accomplished quickly by touching-up with small quantities of the epoxy.

—The End

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Importance of Fabrication on the Properties of Silicone–Glass Laminates

The effects of many variables in the composition and physical make-up of the laminates provide useful data for the design engineer.

WHILE many are familiar, at least in general, with the make-up of laminates, it is desirable to mention the various types of resins and reinforcements used to produce silicone laminates. The greatest present user of silicone laminates is the electrical industry. In this industry, flat sheet laminates are used to make slot wedges, spacers, mounting boards, insulating washers, foil forms, and similar related parts for use wherever the service conditions require a material that will withstand heat, moisture, electrical stresses, arcing conditions, ozone, or any combination of these severely degrading environments.

For typical electrical uses, the laminates are made of a high-pressure silicone resin and one of the finer weave glass fabrics. The high-pressure resins are used because the laminate fabricators are set up to mold at pressures of 1,000-1,500 psi. owing to the requirements of the phenolic and melamine resins they also mold. The actual choice of which high-pressure resin to use depends primarily on the particular combination of temperature and electrical stress involved in the specific application.

The glass cloth reinforcement generally is 112 or 116 cloth because these finer weaves give better electrical properties. The superior machinability of the finer weaves also is important because many of the uses require some type of machining or punching. Lately, there has been quite a bit of interest in the HG-type substitutes because of their lower cost.

Many of the applications for reinforced silicone-laminates demand that the parts be molded to shape. In such uses, the low-pressure resins provide the opportunity of taking advantage of much cheaper molding techniques. The low-pressure laminating resins can be molded in complex shapes by the use of bag or matched metal molding techniques. Such items as radomes, heating ducts, tubing, coil forms, and missile parts have been produced with low-pressure techniques.

Effect of Fabric Finishing

The original sizing on glass fabric is incompatible with silicone resins and, therefore, must be removed. This can be done by washing and/or heat-cleaning; in most cases, no significant differences can be found between the cleaning methods, provided all of the sizing is removed. However, water rinsing a heat-cleaned glass fabric results in more consistent optimum physical properties with silicone resin. The results of such washing are shown in Table 1. In this Table,

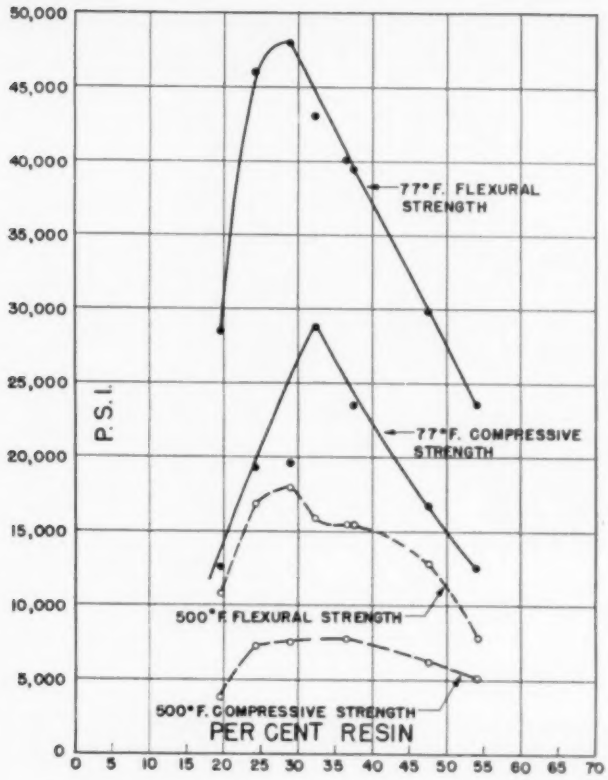

Fig. 1. Effect of resin content on laminate flexural and compressive strengths at 77 and 500° F.

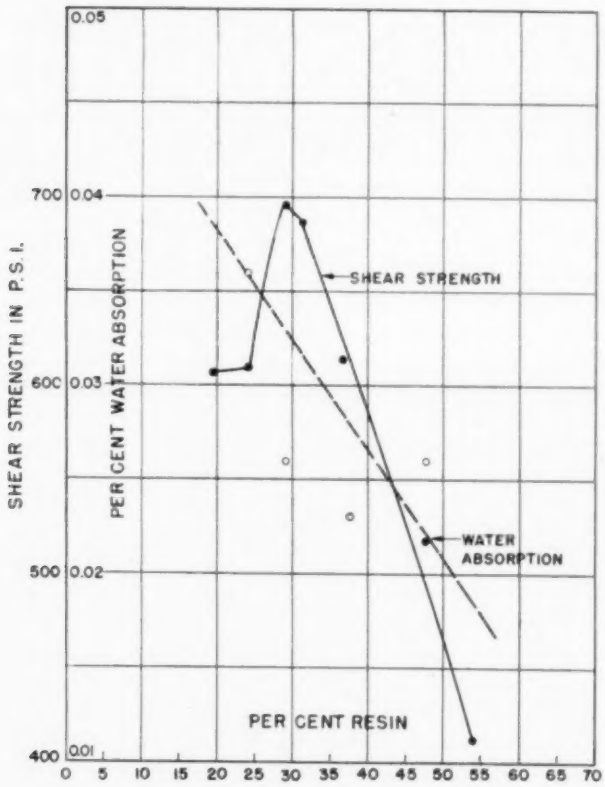

Fig. 2. Effect of resin content on silicone laminate shear strength and water absorption properties.

all fabric was heat-cleaned and the laminates were made with D-C 2106 resin molded at 30 psi. and 350° F.; after-cured for 12 hours at 482° F.; and tested in accordance with LP-406b. The residual alkali found on the surface of heat-cleaned glass cloth can catalyze the silicone resin in such a way as to result in brittleness at room temperature.

The finishes available for glass cloth can be evaluated by considering their effects on the resin. Volan A or 114 finish reacts unfavorably with materials used to catalyze the resin, thus making control of flow and gel time very difficult. Any of the finishes containing sodium ions that are subsequently washed off are usable if the sodium ions are removed completely. Variations in removal of the sodium ions from roll to roll with such finishes has discouraged their use in commerical production.

Other than causing coating difficulties, this type of finish has little effect on the laminates, either good or bad. In general, all of the other finishes are usable with the silicone resins, but offer no particular advantages or disadvantages. A new universal finish has been offered recently. This finish seems to give more uniform coating properties from roll to roll when used with the silicone resins. The properties of laminates made from fabric finishes with this material are similar to those obtained with carefully controlled heat-cleaned and washed fabric.

Correlation of glass tensile strengths with laminate flexural strengths has been very poor, and some of the values obtained are shown in Table 2. In this Table, all fabric was heat-cleaned and the laminates were made with D-C 2106 resin molded at 30 psi. and 350° F.; and after-cured for 12 hours at 482° F.

Effect of Impregnation Variables

The impregnation and pre-cure steps of silicone laminate production are the most critical of the production variables. The silicone resins are solvent solutions. The fabric is passed through the resin solution in order to achieve the desired impregnation, and then through a drying tower to remove the solvent and advance the cure of the resin to the desired point. The control possible through varying the temperature and time of the pre-cure, plus the amount of catalyst added, enables the coater to produce impregnated fabrics with many varying resin contents, volatilities, gel times, and amounts of flow. The effect of catalyst concentration on the flow and gel time are shown in Table 3. In this Table, the resin used was D-C 2106, 35% impregnated on 181-112 fabric, and pre-cured for 8.5 minutes at 320° F.

The effect of pre-cure time is shown in Table 4. Table 5 shows the effect of pre-cure temperature. The data shown in both Tables was obtained with D-C 2106 resin, 35% impregnated on 181-112 fabric, using the recommended catalyst concentration and pre-cured at 230° F. For Table 5, pre-curing took place for 10 minutes at the indicated temperatures.

The resin content of silicone laminates has a considerable effect on their strengths. The optimum content for bag-molding has proved to be 35%. Flexural strength variation with resin content is shown in Table

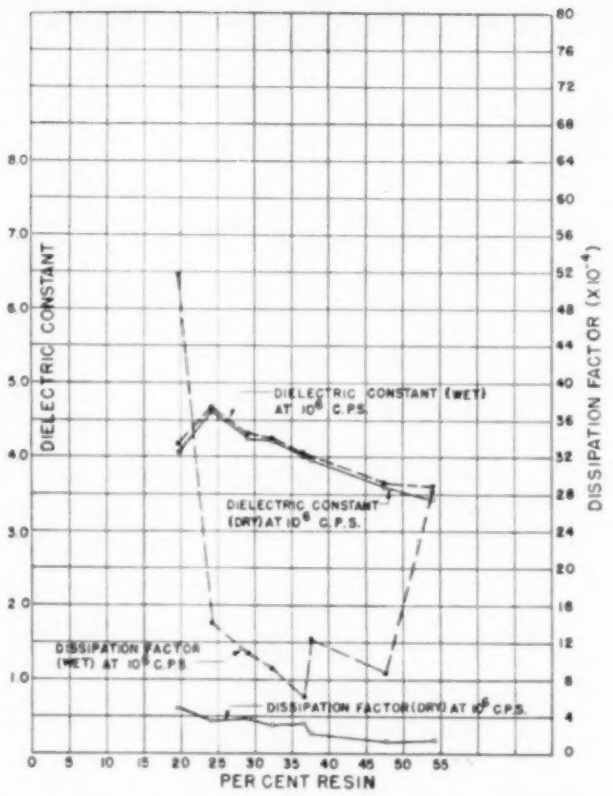
DIELECTRIC CONSTANT
DISSIPATION FACTOR (X10⁻⁴)
DIELECTRIC CONSTANT (WET) AT 10⁶ C.P.S.
DIELECTRIC CONSTANT (DRY) AT 10⁶ C.P.S.
DISSIPATION FACTOR (WET) AT 10⁶ C.P.S.
DISSIPATION FACTOR (DRY) AT 10⁶ C.P.S.
PER CENT RESIN

Fig. 3. Effect of resin content on electrical properties of laminates.

6. The laminates used for this data were made with 14 plies of six by six-inch pieces of 181-112 fabric impregnated with D-C 2106 resin, bag-molded at 350° F., and after-cured for 12 hours at 482° F.

The optimum resin content for press-molded laminates made at 30 psi., using 181 fabric, is 30%. The effect of resin content on several properties of such laminates is shown in Figures 1-3. Higher resin contents give lower water absorption, and slightly better dissipation factors and dielectric constants, but the physical properties fall off rapidly.

The volatile content of the impregnated fabric can have an effect on physical properties. Samples of coated fabrics with identical flows, gel times, and resin contents, but with differing volatiles, were tested. The material with the highest volatility had a slightly better "drape," but the physical properties of the resulting laminate were poorer, both when bag-molded and when molded at 30 psi. The actual values obtained in these tests are shown in Table 7.

Effect of Fabrication Variables

The fabricator of silicone molded parts has a great number of variables to control, particularly if he molds at low pressure. The variables such as resin content, volatility, flow, and gel time are controlled by him in his specification for pre-cured, impregnated fabric. In addition to these, however, such things as orientation of plies, size and thickness of lamination, molding pressure (in some cases), molding temperature, and method of after-bake all have an effect on the properties of the finished part.

The orientation of the plies of fabric in complex shapes causes considerable variation in such laminate properties as flexural strength and modulus. By testing flat oriented sheets in various directions, some idea of these variations can be obtained. The variation in modulus could be used to control the stiffness of the finished article in any one particular direction. Table 8 gives the flexural strength and modulus values obtained on a parallel lay-up of 181-style fabric when tested in warp, fill and 45° directions. The resin used was D-C 2106, and the laminates were molded at 30 psi. pressure and 350° F., and after-cured for 12 hours at 482° F.

The effect of fabric orientation must be considered in all testing and fabrication of reinforced laminates. Since the results do vary considerably, it is imperative that some indication of lay-up direction be given with any tabulation of data. In checking lay-up direction effect with silicone resin laminates, the following were noticed: If parallel lay-ups of 181-style fabric are used, it makes considerable difference which side of the laminate specimen is tested under compression when flexural strength is obtained, and a variation of 10-15% in the test results is quite common. If the alternate plies are inverted to give an interlock of the 181 fabric pattern, the variation due to which side of the sample is up when tested in reduced, but the difference in results when tested in lengthwise and crosswise directions still remains.

Interlocking of the fabric pattern also can be obtained by rotating alternating sheets through 90° from the straight parallel lay-up position. Such a laminate, however, gives flexural values about equal to the average of lengthwise and crosswise test results on a parallel lay-up. The effect of which laminate surface is up also is minimized. Unless stated otherwise, the lay-up of all laminates studied was done by the 90° rotation of alternating sheets method. It is felt that such values are true representations of what could be expected in field use where warp and fill directions cannot always be controlled or determined.

The pressure used to mold can have an effect on the properties of the resulting laminate. Even though the resin discussed here was designed for use at low pressures, it can be catalyzed for use at high pressures. The laminate values obtained with high pressures sometimes are not as good as those obtained at low pressures, but probably are more consistent. Table 9 gives representative values for laminates molded under vacuum pressure, 30 psi., and 1,000 psi. The specimens

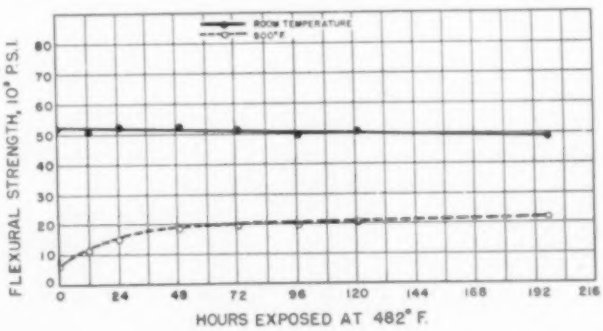

Fig. 4. Effect of after-bake time on laminate flexural strength at room temperature and 500° F.

Table 1. Flexural Strengths Of Laminates Made With Washed And Unwashed Glass Fabric

Fabric 181-112	Flexural Strength, Psi. At 77° F. Unwashed	At 77° F. Washed	At 500° F. Unwashed	At 500° F. Washed
Roll A	28,600	42,700	15,200	16,000
B	30,200	45,100	16,600	16,600
C	34,400	42,900	17,500	16,000

Table 2. Effect Of Fabric Tensile Strength On Flexural Strength Of Finished Laminate.

Fabric 181-112	Tensile Strength, Psi.	Flexural Strength At 77° F., Psi.
Roll A	120	33,000
B	150	35,000
C	140	42,000
D	203	36,600

Table 3. Effect of Catalyst Concentration On Flow and Gel Time.

Percent Catalyst	Percent Flow	Gel Time, Min.
0.05	14.6	7.0
0.07	15.1	6.5
0.10	15.5	2.5
0.15	14.4	2.0

Table 4. Effect Of Pre-Cure Time On Flow And Gel Time.

Pre-cure Time, Min.	Percent Flow	Gel Time, Min.
2	16.4	3.2
5	15.6	3.0
10	13.5	2.8
20	13.0	2.5

Table 5. Effect Of Pre-Cure Temperature On Flow And Gel Time

Pre-cure Temperature, ° F.	Percent Flow	Gel Time, Min.
194	16.0	2.8
212	16.0	2.8
230	15.5	2.5
248	12.5	2.5
266	11.4	2.2

Table 6. Effect Of Resin Content On Flexural Strengths Of Bag-Molded Laminates

Resin Content, %	Flexural Strength, Psi. At 77° F.	At 500° F.
25	25,800	5,000
35	38,900	11,600
45	27,100	6,500

were made up of 14 plies of eight by eight-inch pieces of 181-112 fabric, 35% impregnated. The resin used was D-C 2106; coated on the fabric at 350° F.; and after-curing was done at 482° C. for 12 hours.

The temperature of molding low-pressure laminates can have a serious effect on their physical properties. The actual effect is dependent on the degree of consolidation of the laminate during molding. Higher temperatures give lower viscosities of the resin before gelation, but the amount of time for resin flow-out and volatile dissipation is shorter. Low temperatures give longer gel times so that resin flow-out can occur, but the resin viscosity may be too high for good consolidation.

Several laminates were molded under vacuum pressure in Silastic bags to check the effect of oven temperature on the flexural strength of the resultant laminate. The results of this test are shown in Table 10. All laminate specimens were molded of six plies of D-C 2106 resin on 181-112 fabric, and all, except "A", had 30 minutes at temperature and were after-cured for 12 hours at 482° F. "A" was an attempt to duplicate a very slow heat-up, and consisted of 30 minutes at 250 F., 30 minutes at 300° F., and 60 minutes at 350° F. Table 10 shows that a molding temperature of 175° C. gives the best results. This could be considered natural, since 175° C. was the temperature standardized on when the original resin formulation was developed.

The time at temperature during molding of silicone laminates is dependent on the thickness and construction of the part and the temperature of molding. Thin sections (0.005-0.030 inches in thickness) have been molded in matched dies at temperatures of 500-600° F. in as little time as one minute. Parts so molded can usually be removed from the mold hot. Of course it is doubtful if such parts have the optimum properties possible, but they have been proved to be very successful in the cases where such techniques have been used.

If molding can be done at high pressures, the effect of temperature versus flow discussed above is minimized. In such cases, the higher molding temperature speeds the cure of the resin, allowing shorter press times and (in special instances) removal of the molded part without first cooling the mold. Using conventional molding temperatures necessitates cooling the laminate before pressure is released in order to realize the optimum physical and electrical properties in the laminate.

Effect of Post-Cure

Silicone laminates must be post-cured or after-baked to complete the resin cure, and to obtain the best properties at elevated temperatures. The post-cure generally entails a graduated temperature rise to 482° F./over an eight-hour period, plus varying times at 482° F. Table 11 shows the effect of cure time at 482° F. on the flexural strength of the laminate at room temperature. The laminate specimens were molded of 14 plies of D-C 2106 resin on 181-112 fabric at 30 psi. pressure and 350° F.

The gradual rise in flexural strength with increasing time of post-cure is illustrated further in Figure 4. The flexural strength at 77° F. is slightly lower after 200 hours at 482° F., while the strength at 500° F. is

still rising. This graph also illustrates the excellent heat stability of the silicone laminates at elevated temperatures.

Some of the effects of fabrication variables have been evaluated from the glass cloth to the finished laminates. Most of the test results have been reported in flexural strength. One phenomenon has been observed with silicone laminates that appears to be decidedly different from those of other resins. When tested according to Federal Specification LP-406b, Method 1031 for Flexural strength, silicone laminates give increasing values with decreasing sample thicknesses. This is directly contrary to the results reported for polyester resins. The actual values obtained in one series of the tests are given in Table 12. The laminates were molded of D-C 2106 resin on 181-112 fabric at 30 psi. pressure and 350° F., and after-cured for 12 hours at 482° F.

Table 7. Effect of Resin Volatility and Molding Method On Laminate Flexural Strength.

Resin Volatility	Molding Method	Flexural Strength, Psi. At 77° F.	Flexural Strength, Psi. At 500° F.
High	Press—30 psi.	39,000	15,400
Low	Press—30 psi.	42,300	15,100
High	Bag molded	26,300	9,700
Low	Bag molded	30,600	11,100

Table 8. Effect Of Fabric Orientation On Laminate Flexural Strength And Modulus.

Direction of Test	Flexural Strength, Psi. At 77° F.	Flexural Strength, Psi. At 500° F.	Flexural Modulus, x10⁶ Psi. At 77° F.	Flexural Modulus, x10⁶ Psi. At 500° F.
Lengthwise	43,100	17,000	3.1	2.1
Crosswise	40,600	16,100	3.0	2.0
45°	17,800	9,300	1.2	0.5

Table 9. Effect Of Molding Pressure On Physical Properties Of Laminate.

Molding Pressure	Flexural Strength, Psi. At 77° F.	Flexural Strength, Psi. At 500° F.	Tensile Strength At 77° F., Psi.	Compressive Strength, Psi. At 77° F.	Compressive Strength, Psi. At 500° F.
Vacuum	37,900	10,800	—	—	—
30 Psi.	46,400	15,500	37,700	13,300	4,000
1,000 Psi.	36,100	16,700	36,500	12,100	4,600

Table 10. Effect Of Molding Temperature On Flexural Strengths Of Bag-Molded Laminates

Oven Temperature ° F.	Flexural Strength At 77° F., Psi.
"A"	23,500
350	43,100
440	32,200
480	30,300
530	20,200

Table 11. Effect Of After-Cure Time On Laminate Flexural Strength

Time at 482° F., Hrs.	Flexural Strength, Psi. At 77° F.	Flexural Strength, Psi. At 500° F.
4	44,100	12,500
12	44,300	15,700
24	44,900	17,300
36	44,800	17,700
48	45,000	18,700

Table 12. Effect Of Laminate Thickness On Flexural Strength.

No. of Plies	Thickness, In.	Flexural Strength, Psi.
4	0.032	56,400
8	0.073	44,800
12	0.116	39,300
17	0.147	37,400

Conclusions

This paper has dealt with the variations in laminate properties caused by washed versus unwashed glass fabric; cloth tensile strength; catalyst concentration; pre-cure time and temperature; resin content; fabric orientation; molding method, pressure, and temperature; post-cure time; and laminate thickness.

A great number of variations can affect the results obtained with silicone resin laminates. The relative newness of the resins means that a great deal of engineering information is unavailable because either it has not been obtained, or there is no workable method for gathering the information from those who possess it and transmitting the information to those who need it.

If temperature or electrical requirements, or a combination of both, suggest the use of reinforced silicone laminates, the best method available today of finding out whether they will work is to actually try them. Many people have been very pleased wih the results.

—The End

Willert Replaces Buecken

On PT Editorial Advisory Board

Because of an expansion of his duties with National Rubber Machinery Co., Hans E. Buecken has been forced to resign from our Editorial Advisory Board, effective February 28, after more than four years of service since the inception of PLASTICS TECHNOLOGY. He is replaced as an Equipment man on the Board by William H. Willert, vice president in charge of the Plastics Machinery Division, Frank W. Egan & Co.

Bill Willert was born in Michigan in 1920. He attended Michigan State University and graduated in 1942 with a B.S. in Chemical Engineering. Following graduation, he joined Firestone Tire & Rubber Co. where, shortly thereafter, he was transferred to the company's Plastics Division where he held various positions in research, development, production, and technical service. His major field of specialization was in Velon polyvinylidene chloride monofilaments made by extrusion.

He left Firestone in 1947, and for the next 2½ years was associated with Reeves Plastics, extruders of polyethylene monofilaments, and, concurrently, with Modern Plastic Machinery Corp. Early in 1950, he joined Hartig Engine & Machinery Co. as "assistant general manager" (no one there had a formal title). In August 1952, he joined Frank W. Egan & Co., which marked their entry into the manufacture of thermoplastics extruders. Initially, he designed, sold, and serviced extruders and auxiliary handling equipment, and currently is vice president in charge of the firm's Plastics Machinery Division which manufactures extrusion equipment.

Bill is an active member of SPE's Newark Section, where he has held various offices and is now on the executive committee for the Society's 1959 National Conference (to be held in New York City next January). He also is a member of ACS and Alpha Chi Sigma, and is a licensed Professional Engineer in the State of New Jersey. In addition, he holds several patents and has written various magazine articles. Mr. & Mrs. Willert have three daughters, and reside in North Plainfield, N. J.

—THE END

The Thirty Years of Plastic Impact Testing—Part I.
(Cont'd. from page 230)

Liander, Schaub, and Asplund (24) made a study of some of the factors affecting the impact strengths of a few phenolic molding materials. The effect of velocity was found to be negligible for the range of velocities investigated. The effect of fatigue caused by repeated-blow falling-weight tests was shown graphically on rectangular coordinates, and resembled the rectangular coordinate plot of Hopkins (see Figure 3).

The effect of the slenderness ratio on the results obtained from an unnotched Charpy-type specimen is shown in Figure 5. The slenderness ratio, which is defined as $\lambda = \frac{l}{h}\sqrt{12}$, was shown to have no effect upon the impact flexural strengths of the materials tested for values greater than 30. For a slenderness ratio less than 30, the shear deformation can no longer be neglected. For very short specimens, the penetrations of the anvils into the test specimen were believed to have some effect on the results.

(To be continued in April)

WILLIAM CUMMINGS, *Group Leader, Kralastic Research,*

and

R. L. KNAPP, *Manager, Kralastic Development, Naugatuck Chemical, Division of United States Rubber Co., Naugatuck, Conn.*

Developments in Polyurethanes, Unsaturated Polyesters, Polyvinyl Chloride, and Acrylonitrile Copolymer Blends, 1957.

Polyurethanes

The growth of polyurethanes was accelerated during 1957 by developments in the basic materials and in fabrication techniques. Considerable progress was made toward the goals of lower cost, more reproducible end-products of better quality. Winkler (1)* gave more detail on the use of beta-diethylaminoethyl ethylenediaminetetracetate as a catalyst producing foams having superior humid-aging properties. The effect of toluene diisocyanate isomer ratio on the mechanical properties of foam was studied by Gmitter and Gruber (2). Their results suggest blending to an isomer ratio appropriate to a particular application. A new polyester having a low hydroxyl number an very low acid and water content was announced (3). These qualities give a lower foam density, stronger cell structure, and less batch-to-batch variation.

The development by American Latex Products Corp. of mechanical and automatic equipment to give closely controlled production of large volumes of foam were described (4). Brushwell (5) reviewed polyurethane coating compositions, while Fornwall (6) described the catalyst gun and catalyst meter used in spray applications.

A discussion of requirements in foamed materials for aircraft seats compared the suitability of polyurethanes (polyester and polyether) with latex and polyvinyl chloride foams (7). Two publications (8, 9) on insulation uses of polyurethanes appeared. Zapp summarized the health hazards due to isocyanates in polyurethane production (10). The competitive position of polyurethane, latex, vinyl, and styrene foams was reviewed (11), while the potential of dimer acid polyesters in urethane foams was assessed (12). A weatherstrip produced by foaming polyurethane within a flanged vinyl tube was described (13).

Ogden (14), reviewing polyurethane elastomers, described the unsaturated type which is cured with sulfur and an accelerator, thus giving advantages in processing characteristics and stability during storage and exposure to heat. Castable polyether-polyurethane elastomers were discussed by Dickinson (15). He described work with alkylene oxide-triol adducts as cross-linking agents in these systems to avoid gel build-up experienced with aminoalcohols.

Unsaturated Polyesters

The emphasis during 1957 was on fabrication techniques for reinfocred unsaturated polyester materials. Mireau (16, 17) described the technique of molding symmetrical shapes by delivering a metered mixture of chopped glass and resin to a rotating mold using a traveling probe. This "spin-molding" process gives economic production of parts having shapes corresponding to surfaces of revolution. The Pressurform process of applying glass fiber slurry to a preform screen under pressure gives denser preforms with a uniform distribution of fibers and any desired variation in part thickness (18). Increased production rates

*Numbers in parentheses refer to bibliography at end of article.

of safety helmets at Structurlite Plastics were realized with the use of automatic rotary preforming (19). Greater part uniformity also resulted. Love (20) described "membrane molding"—the use of a polyvinyl alcohol membrane having the shape of the part in place of the conventional bag. This results in fewer voids, greater transparency, and higher strength with less warping due to fiber stressing. Case histories of design in reinforced polyester were given by Petretti (21) for a cash register housing, and Oleesky (22) for a three-ton radome. Marzicola discussed the design and construction of the waterjet LCVP using honeycomb-laminate over a wooden frame (23). The problems in molding thick polyester laminates (principally avoiding high peak exotherm in the interior) were studied by Claudi-Magnussen (24).

The appearance of glass flake, and the increasing use of synthetic fibers, either integrally or as overlays, highlighted developments in reinforcements. Developments in silane finishes on glass were described (25). Rugger emphasized the advantages in higher stiffness and lower cost in his discussion of glass-flake reinforcement (26). Higher glass contents also can be realized with this material. Comparison of synthetic fibers with glass reinforcement by Green and Mayo (27) showed the differences in such properties as moisture absorption, corrosion resistance, dielectric properties, abrasion resistance, and surface appearance. The contribution of glass veils and overlays to the improvement of surface smoothness, appearance, and chemical resistance was discussed (28). Adams and Sonneborn dealt with the manufacture and economics of glass reinforcement, and the selection of a type suitable for a specific use (29). The effect of fiber location on mechanical properties of 181 glass cloth laminates was discussed by McGlone (30).

A review of outdoor weathering of glass-reinforced laminates by Gilman (31) includes data from government sources that might have escaped the attention of the general reader. Wahl and Preston concluded, from a study of surface cracking in heat-resistant (triallyl cyanurate) polyester laminates (32), that an asbestos felt overlay on both surfaces afforded one of the best ways of avoiding this defect. Use of the superposition principle in treating heat-aging data for heat-resistant laminates was discussed by Doyle (33).

Relation of a rapid measurement of plasticity in polyester laminates, to degree of resin cure, was shown by Coggeshall to be useful in quality control (34). Cywinski reviewed curing methods for polyester resins (35), while Bennett and Hayes described measurement of cure using the Wallace Microindentation Tester (36). Evidence for a deformable glass-resin bond was found by Hooper (37) in measurements of flexural fatigue, flexural strength, and dynamic modulus of laminates made at two cure rates and with various glass finishes. Flexural fatigue was also measured by Boller (38) on laminates made with conventional and heat-resistant resins. The effect of notching, fabric, resin, stress level, and angle of lay-up to warp were noted.

Della Rocca gave a detailed analysis of reinforced plastics in boat hull construction (39). Fabrication of four new automotive parts (40) and commercial vehicle bodies (41) was described. Stationary tanks of greater than 50,000 gallon capacity were constructed by Microcell, of England, by bolting together modular panels at lip edges with a gasket (42). Chemical industry applications were discussed by Gackenbach and Estey (43). Case took a critical look at reinforced plastic pipe (44) from the standpoint of markets, properties, availability, and future, while Kellam gave an evaluation of its use in underground high-pressure electrical transmission conduits (45).

Two publications gave details on formulating, mixing, and use of premix molding compounds (46, 47). Knuth and Bavley described novel unsaturated polyesters that are linear polyesters of citric acid esterified with a glycol and allyl alcohol (no added monomer) (48). A polyester formulation with methyl methacrylate, in addition to styrene or vinyltoluene, for better ultra-violet light resistance and less fiber bloom was announced (49). Among the new materials introduced were a new hand lay-up resin for boat fabrication (50 a, b); a low shrinkage, low temperature-cure potting resin (50 c); improved shell coatings (50 d, e, f); flame-resistant premixes (50 g, h); a new, low cost boat-covering resin (50 i); a low-discoloring binding resin for roving (50 j); and a new heat-resistant resin (50 k).

Polyvinyl Chloride

Among the new uses contributing to the growth in PVC during 1957 were a portable temporary warehouse constructed of vinyl-coated nylon fabric and supported entirely by low-pressure air (51), thermoformed television scenery (52), and a garden hose consisting of an extruded PVC core reinforced with nylon cord with an outer wall of abrasion-resistant plastisol (53). Pressure-formed vinyl sheeting over a cardboard core was used in construction of a display box (54). Gold reviewed adhesives for vinyl film laminations, covering types of adhesives, laminating methods, and evaluation of products (55). U. S. and British practice in laminating to metal were reviewed (56), while use in flooring was covered by Bulkley and Stockwell (57).

Chemical blowing of PVC with N,N′-dimethyl-N,N′-dinitrosoterephthalamide was covered by Fuller (58), while McLain gave a treatment of cellular vinyl foams in general (59). Foaming by release of carbon dioxide previously absorbed by a plastisol during countercurrent flow in a tower was described (60). Advantages in being able to store and pipe the pressurized plastisol were emphasized. Foam density is controlled by the carbon dioxide pressure, while fusion of the foamed plastisol is accomplished with high frequency radiation.

Werner pointed out the usefulness of the Severs Extrusion Rheometer in measuring plastisol viscosities, particularly at high shear rates (61). Proper interpretation of flow curves can be useful in avoiding costly plant trials. Resin particle size, size distribution, plasticizer type, diluent, and pigment were found to influence plastisol flow in a study by Frey (62). A review of plastisols (63) covered basic ingred-

ients; coating applications; cast film and coatings; dip, slush, and rotational molding; and use in clay pipe joints.

Himmler and Nissel found a large heat build-up in non-rigid vinyl compounds during processing at high mill-roll surface speeds. They developed a new heat stability test (64) for calendering compounds to be used under such conditions. A test for calender roll plating developed by Howard and Hess (65) gives a quantitative measurement. Their results show that the barium-cadmium stabilizer is the principal cause of plating. The Ba/Cd ratio is also involved. New developments in calenders were described by Gooch (66). Malone (67) covered extrusion of rigid vinyl from the stand-points of equipment, control, sizing, cooling, and take-up. A new test specimen for study of resistivity during water immersion was described (68) that uses as little as 75 grams of plasticizers.

Fillers for vinyl were discussed by Phillips and Youde (69). Advantages of new isosebacate esters as plasticizers were pointed out (70). Luijten and Pezzaro found di-n-octyltin compounds to be practically as good heat stabilizers as the dibutyl-type and less toxic to mammals (71).

Acrylonitrile Copolymer Blends

A milestone in the development of these high-impact materials was passed when the number of miles of Kralastic pipe in service passed the 6,000-mile figure (72). The desirable combination of physical properties of this material, including toughness and chemical resistance, were seen as responsible for this development in pipe use.

A review of the field performance of Kralastic pipe during six years of successful use in oil fields was presented (73). Irvin and Multer (74) compared rigid thermoplastic pipe materials from the standpoint of strength properties, service conditions, and installation methods. Material and installation costs for these materials were compared to steel. Trunk (75) discussed screw design to obtain maximum surge-free production of ABS blends under various conditions of back pressure and die dimension.

Elimination of leak patching and repair of rotary filters conveying ferric chloride solutions was seen as the advantage in replacing copper with acrylonitrile copolymer blend pipe in a sewage treatment works (76). Development of test methods and standards for plastic pipe were discussed by Kuhlmann (77).

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e. Vibrin Shellcoating A-601.
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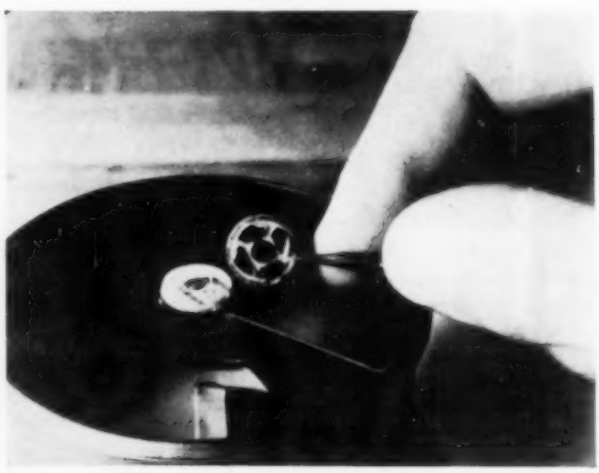
—THE END

Tiny Plastic Laminates

The U. S. Army Signal Corps' "Weather Eye," a delicate instrument for measuring radiation reflected by the earth's cloud layer, utilizes four pieces of laminated plastic—each smaller than a dime! In construction, each weather-eye utilizes a f/0.7 mirror, three inches in diameter by 3/16-inch thick, plus a 1/25- by 1/25-inch detector unit. These are cemented in place over the center hole of a laminated plastic printed circuit.

Another plastic laminate holds a silicon solar battery for sending light signals. The two other laminates serve as insulating spacers. Perkin-Elmer Corp., Norwalk, Conn., developed the optical unit. The plastic material used was Phenolite Grade G-10-865, a continuous filament-type glass cloth bonded with an epoxy resin. This material is a product of National Vulcanized Fibre Co., Wilmington, Del., and was selected for its dimensional stability, lightness, and temperature resistance.



Plastic laminate holds a silicon solar-battery system.

Edited by:
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Compression & Transfer Molding

I should like to challenge and comment on the following statements which appeared in John Woodruff's Forum column in November, pg. 915:

I. "I feel that cost analyses made by the captive companies, based on automatic molding, show up many savings which cannot be attributed merely to automatic molding. The custom molder provides many expensive services, sales, estimating, engineering, purchasing, mold repair facilities, quality control, shipping, etc., which appear in his costs, but not in the captive companies' molding cost study."

Answer: First of all, the captive molder provides *everything* listed above except sales and shipping. Secondly, these all appear in the molding cost study under the heading of overhead. I am quite astounded that Mr. Woodruff would make such a statement; after all, the large corporations are better equipped to break-down costs than are small molders, and they certainly would never overlook these items in their analyses.

II. "The actual direct savings contributed by the automatic press are the operators' wages."

Answer: Elimination of operators is one factor and a big one; however, there are others:

(A). Rejects are cut substantially. With an Automatic, the set-up is performed to produce an exacting piece, and each additional piece is identical. Automatics also allow for closer tolerances. This is obviously not true with a manual operation where the operator functions differently with each cycle.

(B). Mold costs are lower. Invariably, there are fewer cavities where an Automatic operation is set up.

(C). Perform presses are eliminated. These are expensive units. Also, all the handling is eliminated, as is all the handling labor. Storage area of preforms is eliminated.

(D). Inventory is kept at a minimum. Parts can be molded as required or controlled inventories maintained. Large stocks do not occupy valuable space.

(E). Production is increased. Each press cycle is identical; no seconds are wasted. Maximum efficiency is continuous.

(F). Material is saved. Each cavity charge is accurately metered. With a Baker, there is no spillage of material. With automatic operation, flash waste also is reduced considerably.

In addition to the above, quality is improved and many production economies are realized.

III. "Automatic presses are very expensive, and the depreciation and interest on the investment approach the operator's wages."

Answer: First of all, you cannot compare the price of a new Automatic to a manual press bought 20 years ago. Obviously, the cost is considerably higher. Use 1957 costs on both machines for a better comparison.

Let's figure a new 60-ton Baker Automatic at $12,000:

On a 5-year basis, depreciation on	
$12,000 at 5%	=$2,400.00
Interest at 5%	= 600.00
Total	$3,000.00
On the other hand, 5,000 hours of	
labor saved @ $2.00 per hour	=$10,000.00

Even on a five-year write-off, the direct labor saving is over three times the depreciation and interest and, of course, the direct labor saving increases each of the five years.

IV. "The Custom Molder sees two distinct disadvantages to the Automatic press; lack of flexibility, and lack of suitable jobs."

Answer: As to flexibility, I am absolutely certain that Mr. Woodruff and many other custom molders have

(Continued on page 246)

*This column replaces John H. Woodruff's Forum this month.

(*Continued from page 245*)

not carefully examined the Bakers. Many of our customers are purchasing these presses solely for this feature alone.

Consider these:

(A). Four open sides. You can feed from one side, strip out another and load inserts from another and still have an open side. Another example—you can strip one side, feed another, use an oil heater for mold temperature and have an open side. Our loading mechanism and our stripping device are all on threaded rods for various mold heights.
(B). You can decelerate at any point in the pressing stroke.
(C). Safety device is adjustable to any point.
(D). Breathe cycles are instantly adjustable for any time and any length of time, for instance:
(1). Under no pressure:
(a). Come down—pause for delayed period—then continue down.
(b). Come all the way down—pause on material—back off to breathe switch—pause—then come down.
(c). Come down and right back up to breathe switch—pause—then come down.
(d). Come down—right back up, right back down, without pause.
(e). Come down — pause — backup - - right back down.
(2). Under pressure:
(a). Come down—pause for delayed period—then continue down.
(b). Come all the down—pause on material—back off to breathe switch—pause—then come down.
(c). Come down and right back up to breathe switch—pause—then come down.
(d). Come down—right back up, right back down, without pause.
(e). Come down — pause — back up — right back down.
(E). Independent lower hydraulic ejection—fully adjustable and can also be used as follow-up.
(F). Independent upper hydraulic ejection—fully adjustable and can be used as follow-down.
(G). Universal measuring and loading device. The individual rows are movable backwards or forwards, or can be eliminated entirely. The individual cups are movable right, or left, or can be eliminated.
The measuring feeder also is universal. The tubes are on ball joints that permit them to be directed in any direction or shut off entirely. This arrangement likewise allows several tubes to be shot into extra large cups. This measuring device is instantly adjustable by set nuts on back of feeder.
Tube charge capacity is 5.2 cc. minimum, 87.7 cc. maximum with single shot; 175.4 cc maximum with double shot.
A 40-cavity mold arrangement can be changed to six-cavity or twelve-cavity, or any other mold arrangement desired, in a matter of a few minutes and without extra expense. Everything is provided in the initial purchase.
(H). Automatic compression to transfer, all on the same press. By switching one button and changing from a compression mold to a transfer mold or vice versa, you can go from one to the other; all on the same press.
(I). Automatic side cores, all sequenced into the press operation automatically.

As for flexibility, the press has every conceivable cycle known, all instantly adjustable as to time and length of function. If hot powder is desired, two C-clamps and electrical connection are disconnected, and a powder preheater quickly interchangeable. No one could possibly state this press does not have flexibility. Flexibility is its most important quality.

V. "There definitely are many parts which should be molded on automatic presses, but over-all economies dictate that the customer mold them himself."

Answer: This is a defeatist attitude. The customer could do all his own work, and then there would be no customers. The captive is continually tempted to set up his own molding operation as part costs remain high. Again, this move would be considerably less attractive if new automatics were installed by the custom shop and savings initiated. Mr. Woodruff admits "the volume jobs belong in the captive shops." When this becomes true, will he then say that the medium-volume jobs belong in the captive shop? And, after that, of course, the short-run jobs also. I think it behooves the custom molder to take immediate steps to stop this trend. This could also take place in injection. Some morning, the custom molder could wake up and find no custom molder.

VI. "Furthermore, the molder's profit margin is now extremely low."

Answer: This is due to a lack of forward thinking on the molders part because:
(A). They did not guide the users to better designs.
(B). They did not work with the user to eliminate inserts but preferred to take expensive piece parts to increase billings. The molder has gotten himself in a corner with old equipment, old methods, and poor customer relations. They should educate the user in high production, low cost, automatically molded pieces. Educate them to possible cost savings through redesign, elimination of inserts, etc., to enable you to cut costs and furnish them with a part at lower price to make their products more competitive.

VII. "In the September issue of British Plastics, there is also a rather pessimistic editorial on the future of phenolics."

Answer: I cannot, of course, alter the British outlook. I might add, however, that there is a realistic editorial on compression molding on page 899 of the November issue of PLASTICS TECHNOLOGY.

—THE END

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Moldmaking & Tooling

Quality Control In Moldmaking

WHEN a moldmaker delivers a finished mold to a molder, it is usually, then, set up in a press for its initial test run. After this test run, it is not unusual to find that the mold must be returned to the moldmaker for one or more of a number of reasons. Needless to say, this is irksome to both parties as it involves an additional shipping cost, press down-time, and additional work for all concerned.

Usually, the reasons causing the mold to be returned are minor. When a mold cannot immediately assume its production activities, however, comments are made about its quality. When we think of quality in a mold, we usually associate this with workmanship only. It is true that workmanship is a mighty important element in moldmaking, and I do not intend to minimize its position. However, there are other factors, not strictly in the category of workmanship, that can cause a mold to be returned and reflect on its quality. Let us then, for the purposes of this discussion, eliminate workmanship and consider some of these other factors.

If I were asked to list the most common items of error that have caused molds to be returned, many would be surprised at the relative minor importance of these items. This is perhaps the reason of their frequency of occurrence. Because they are of a minor nature, not enough attention is given to their correction.

Let me list these items in the form of a question that might be asked by the moldmaker from the molder at the time the initial mold design is being prepared:

(1). Indicate position of the K/O pins.
(2). Indicate position of cavity numbers (if any).
(3). Indicate position of trademark (if any).
(4). Check or indicate position and dimensions of gates, runners, and sprue bushings.
(5). Indicate drafts required in amount, as well as the direction in which they are to be applied.
(6). Indicate dimensions and actuation features of the K/O bar.
(7). Indicate the identification to be stamped on the outside of the mold.
(8). State name, size, and type of press in which the mold will be run.
(9). Check or indicate position and number of cooling or heating lines.

If the foregoing would always have had received the proper attention by both parties, many molds would not have had to be returned for correction.

Let us discuss them one by one. First, the position of K/O pins. All too often, this item does not receive the discussion it deserves. Since K/O pins leave marks on the part, the tendency is to cut down on them wherever possible. In addition, attempts to hide them often puts them in a spot where they cannot do their job.

Items 2 and 3 need little comment other than to make sure they are not forgotten. It is much easier to stamp or engrave a mold detail before the mold has been hardened.

Item 4, concerning the dimensions of gates, runner systems, sprues and the like, certainly leaves the field wide open for "Monday Morning Quarter Backs." Getting the material into a part to be molded is one of the most important features of molding, and certainly deserves equal attention with the part to be molded. The background of experience of the molder on similar parts should be considered before the mold is completed—not after. *(Continued on page 249)*

Edited by:
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Reinforced Plastics

Need For More R.P. Information To Prospects

THOSE of us in the reinforced plastics industry experienced an added thrill to the excitement surrounding the successful launching of the "Explorer." This was in the news that two essential large rings surrounding the missile at strategic points of its construction were fabricated of fiber glass laminates.

This marks another milestone in the progress of reinforced plastics molding which generally made its debut in garage operations after the war when enthusiastic and visionary disciples of this technique created products by means of a simple lay-up method. Today, reinforced plastics is accompanying the satellite to new horizons in research and progress. In my previous column, I speculated that future space stations might be fabricated with this durable, designable, non-corrosive, and lightweight material.

Statistics indicate that less than 5% of each missile produced utilizes reinforced plastics materials. It is estimated that 85% of each missile could be made of reinforced plastics. I believe that lack of adequate information about reinforced plastics and its many inherent qualities is one of the chief reasons why this versatile material has not been adapted to a larger use by those associated with the missile program.

This lack of adequate information became quite evident about three years ago when we conducted a research program among fleet owners of delivery-type vehicles. Because of our success with the prototype, as well as the production units, of the United Parcel Service truck, we were interested in promoting this type of truck to the food and laundry delivery fields. The reduction in payload, easy-to-clean characteristics, simplicity of design, and durability were features of importance to this market.

About 100 top executives in the bakery, fish, meat, and laundry vehicle industries were contacted. A majority of them flatly stated that they would not consider a "plastic" truck because of such reasons as: inferior to metal or wood; not strong enough; will crack; cannot be repaired easily; and too gaudy. Of this group, few seemed concerned about cost and, upon further questioning on this point, the replies generally were that "plastic is cheaper, of course."

Another survey we undertook recently was in the decorative (convoluted) wall field for patios, room dividers, fences, etc. We were interested in making the molds for the finished pieces should an interesting potential exist in this market. Again, over 100 top firms in the outdoor and decorative wall business were contacted.

Here the response was quite the contrary to that in the delivery truck field. Almost everyone questioned had a problem with metal molds for bricks and cast concrete forms. They were eager to have us make r.p. molds for their present large volume of orders, but were not interested in embracing the convoluted wall business. Most of the executives in this field believed plastics to be somewhat of a magic material, inexpensive and capable of solving their corrosion, mold surface, and cost headaches.

One of the largest Eastern cast concrete manufacturers told us, "Forget about those convoluted walls. That business is limited to a handful of old-world architecture. Help solve my metal mold problems and I'll double your present production."

Other manufacturers practically pleaded for appointments to discuss their metal mold problems. This all sounded like a wonderful dream until we started to talk hard facts to them that r.p. is limited in its advantages. We pointed out that in the tremendous volume of

bricks and concrete shapes produced, r.p. molds could not hold up as well as metal; that r.p. was suitable mostly for production units not exceeding 4,000 in volume, and that convoluted wall surfaces were certainly in this category; and that r.p. might cost them six times the amount they now were spending for metal molds.

We also canvassed funeral directors regarding their possible purchase of r.p. caskets. A number of them were definitely buying r.p. caskets, but under other names and were quite adamant in their remarks that they would "never order a plastic casket." Interestingly enough, although selling r.p. caskets for some time, some of the funeral directors were completely unaware that these were made with plastic. The manufacturers realizing the resistance to plastic, called the material by other trade names. These same funeral directors admitted they had no experience with such a casket and were opposed to plastics on the whole because it was "an inferior material," "cheap looking," and "not suitable for such an ethical field."

Trade associations or raw material suppliers (even some with their large promotion budgets) cannot be expected to take on the enormous task of a mass educational campaign for every user's potential markets. The markets depend upon the imagination, know-how and facilities each molder has to offer. The job of informing the prospects is closer to the r.p. molder's area. But few of us in the r.p. field have the sales staff to spread around into unexplored territories. However, we can do a rather effective job by direct mail of keeping prospects informed of r.p., its advantages, its uses, and its limitations.

Of the large number of individuals contacted in our surveys, many indicated that they have no time to browse through their own journals, but are receptive to learning about new ideas if a brief bulletin or one-,page letter were sent to them. The trouble with most direct-mail promotions is that they contain too much literature requiring much reading ime.

Many editors on trade publications might be too busy to attend every trade exhibit or convention in the city. Often times they might miss a molder's new development unless it is brought to their attention by a news release or when they read about it in one of the advertisements. Here, again, it is the job of the individual r.p. molder to keep his public properly informed.

You can't expect the editorial departments throughout the country to include every news release sent to them. They are avalanched by material from all sources each day. Therefore, to supplement the conscientious program which the publications are trying to do (in the face of the high cost of paper, labor, and shortage of space in magazines), you can isolate your particular prospects and keep them informed regularly of your developments by means of a selective, yet inexpensive, direct mail promotion.

When more factual r.p. information is disseminated to broader audiences, we, in the industry, will be dealing with a better-informed and more intelligent market. Looking back, we know that r.p. has come of age, but not enough of the present potential users know that.

—The End

Moldmaking & Tooling

(Cont'd. from page 247)

Item 5, concerning draft or taper, is often overlooked because the part drawing is followed to the letter. In many cases, the originl designer does not show draft on the part to be molded because it is not a function of the operation of the part. In most cases, additional taper can be gotten if requested. At any rate, it should be carefully considered in the early stages of mold constructions.

Item 6, concerning K/O bar features, is merely a matter of checking the design discussion against the actual press features in which the mold will be run. Many molders have special set-ups for K/O mechanisms that are not standard or original parts of the press.

Item 7, again, is simply an item not to be forgotten. In many cases, during the last minute rush to expedite a mold delivery, the part numbers or other elements of mold identification are forgotten. Although this is not a prime factor of mold construction, it can be a source of comment.

Item 8, concerning the press in which a mold is to be run, should be defined carefully as part of the initial mold design. It is indeed embarrasing when a mold will not clear the tie rods, or the K/O holes are not in line with those of the press. Here, again, an early check will eliminate difficulties.

Lastly, Item 9, dealing with the position and number of cooling or heating lines, is of prime importance. Because of other mold elements such as K/O pins, screws, dowels, and etc., it is not easy to add or change the position of a cooling line. Therefore, its initial positioning should be discussed carefully by all parties concerned.

The point I would try to make, is this: Dimensional inspection alone is not a sufficient control of mold quality. Each moldmaker should employ a two-stage check sheet at the start of construction to make sure that all facts were considered and, again, just before delivery, a second check to make sure they were incorporated. Even a small item, like metal chips left in the cooling lines, can be a serious source of trouble and aggravation to the molder.

—The End

The Navy's new whaleboat measures 26 feet in length, and was constructed entirely of fibrous glass-reinforced plastics by Wizard Boats, Inc., Costa Mesa, Calif.

(*Cont'd. from page 231*)

ized processes in thermoplastic and thermosetting materials. In all of the molding courses and in many of the others, he is taken on tours of several different types of plants where the classroom lectures take on meaning, and worded descriptions become working realities. While putting emphasis on practical operations, the courses include sufficient theory to prepare the student for new developments in the industry.

Coincident with the plastics courses, the student is given courses in mathematics, report writing, effective speaking, engineering drawing, mechanics, mechanics of materials, plant layout, instrumentation, hydraulics, industry safety, and problems of supervision.

Upon completion of this well-rounded program, which absorbs three evenings per week for three years, the student has attained a good foundation in the workings of all phases of plastics processing, and he can, with a minimum of field experience, be readily integrated into a plastics plant engaged in almost any type of operation. With the advantage of knowing what is going on in the other parts of the industry, he can meet those who learned "the hard way" on a more-than-equal level. The broad outlook and new ideas that he brings with him make him an asset to any management.

The establishment of the plastics courses at the college, and the sustenance thereof, was and is by no means an automatic process. It was relatively simple to plan a program, but there remained a long gap to be bridged between the vision of classrooms filled with students studying plastics and the reality.

The Education Committee, in conjunction with the College, prepared outlines of all the courses it felt should be included in the program. The college graciously provided the classrooms, but what was to be done about instructors and texts?

The successful launching of the Plastics Engineering Technology Program is a tribute to the character and selflessness of the individuals who comprise our Society. From the Education Committee itself came the first instructors! All busy men, all engaged in many other activities, they gave even more of their time to bring their vision into being. Without textbooks and without previous teaching experience, they entered the classrooms and embarked on the venture of plastics education. It is indeed a credit to these men, and those who followed, that we have never lacked qualified instructors for any of the courses, as they were required.

From this simple beginning evolved accumulations of notes, better course outlines, and plans for permanent texts. This process of growth and improvement is still going on and will continue until all the plastics courses are functioning smoothly.

In the short time that the Certificate Program has been in operation, we have learned much of the industry's real educational needs, and of its reaction to an educational stimulus. Working on the assumption that what was needed most was more supervisory personnel, we established the plastics program on the high-school graduate level.

To our great astonishment, roughly half of the students enrolling in the plastics courses have been graduate engineers and chemists, many with Masters and Ph.D. degrees, heads of departments, and even business owners! One of the reasons for this type of turn-out is embodied in the statement of a chemical engineer, who said, "At college, I learned all about the chemistry of plastics—polymerization, cross-linkages, and such. At my job, I learned how to manufacture the plastic materials. But what do you do with the material after we make it? That's what I've come here to find out!" Other reasons for this turn-out may be that many companies choose to underwrite the courses only for their more valuable personnel, or that the more educated employees most readily realize the advantage of taking the courses.

At any rate, it has become increasingly clear that some training in the "practical" side of plastics is sorely needed at the college level in the engineering curriculum. "Plastics" courses now given at this level deal almost exclusively with the chemistry of plastics with not enough on their usage and processing.

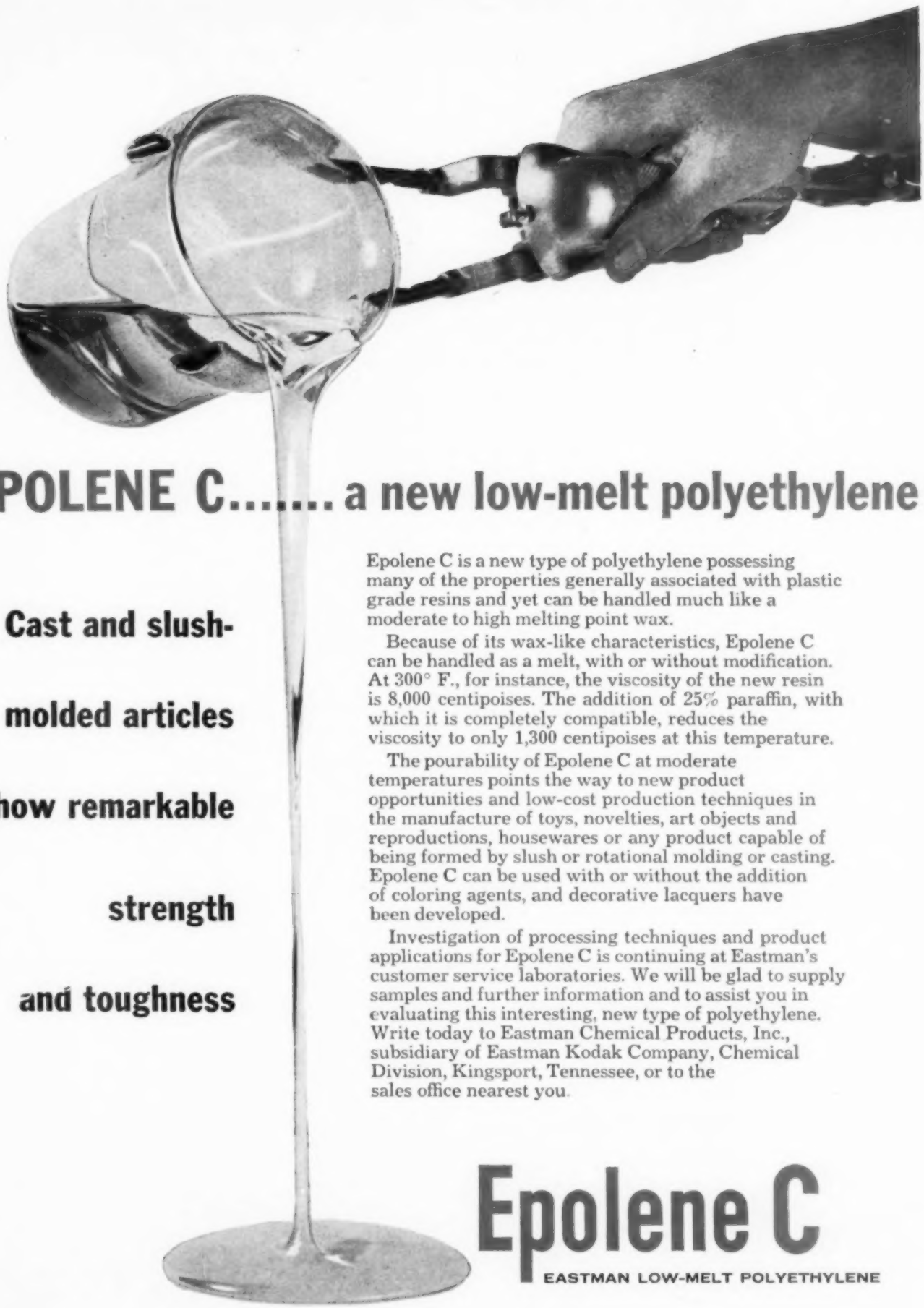
Another thing we have found is that although registrations in the individual plastics courses have been heavy, enrollments in the full Certificate Program have been extremely light. This, we feel, can be attributed mostly to company policy, and indicates an area wherein much work is required. Too many companies are willing to underwrite courses which deal directly with their business, but will not sponsor a student in such "irrelevant" courses as Report Writing or Effective Speaking. If this is true, then the industry is "missing the boat" on developing the type of supervisors it now needs and will need even more in the future.

Here, then, we have another job in education—that of enlightening the industry as to its own needs, illustrating that our program is filling these needs, and urging it to take maximum advantage of the program.

Until the industry has learned to recognize the value of the program, enrollments in the full Certificate Program will continue to lag. Certainly, this lack of recognition is an obstacle to the growth of the program, but we are convinced that this hurdle is a temporary one that is due only to the newness of this activity. We are confident that once the beneficial effects of the individual courses are felt in the industry, enrollment in all phases of the program will be accelerated.

—The End

Du Pont's Combo sponge incorporates a layer of urethane foam for scouring and scrubbing, and a layer of cellulose sponge to absorb moisture and wipe clean. The two layers are bonded together to form a dual purpose cleaning unit.



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News of the Societies

Plastics in Building Illumination

"Plastics in Building Illumination: Daylight and Electric Sources" is the title of the fifth meeting of the Plastics Study Group of the Building Research Institute, to be held on March 5 and 6, 1958, at the University of Houston, Houston, Texas. Open to the public, as well as to members of BRI, the meeting will document the newest technical information on the uses of plastic materials in building illumination.

The meeting will begin with a keynote address, and consist of three sessions at which 11 papers will be presented. The program will close with summations from the building and plastics industries and their viewpoints. The first session, "Objectives of Building Illumination," will comprise papers on performance requirements, the use of daylight, and the use of electric light. The second session, "Objectives of Building Illumination," will include papers on plastics materials available for lighting applications; daylight control with plastics; prismatic control of electric light with plastics materials; diffusion control of electric light with plastics materials; and luminous ceilings of plastics materials. The final session, "Future Applications of Plastics in Building Illumination," will include papers on new plastics light-transmitting products in development; illumination with multipurpose building elements; and illumination quality control.

Additional information on the meeting, as well as registration forms and full particulars, can be obtained from Harold Horowitz, technical secretary, Building Research Institute, 2101 Constitution Ave., Washington 25, D. C.

Society of Rheology

More than 150 members and guests gathered November 7-9 at the Textile Research Institute, Princeton, N. J., to attend the 1957 annual meeting of the Society of Rheology. The first day was highlighted by the presentation of the Society's Bingham Medal to Dr. Clarence M. Zener, Westinghouse Electric Corp.

In his acceptance speech, Dr. Zener stressed the importance of theoretical models in scientific work and pointed out that they not only provide powerful generalizations which serve to unify many observed phenomena into a few, relatively simple concepts; but they also provide the basis for future experiments, the results of which may either confirm the validity of a suggested model or suggest necessary modifications of it.

The meeting's technical program was divided into six half-day sessions. The first session on Thursday morning, November 7, featured two papers devoted to the theory of peeling an adhesive material placed between a rigid plate and a flexible ribbon. In one paper, the adhesive considered was a Newtonian liquid, while the second paper considered the same problem for a Hookean solid. Another paper presented during this session, was concerned with the process of coalescence of the discrete polymer particles of latex dispersions into continuous polymer films. During the Thursday afternoon session, several papers were presented in which measurements of the dynamic mechanical properties of various polymers were reported. One of the speakers described a new type of torsion pendulum without reporting data obtained with the double-transducer apparatus of Fitzgerald and Ferry.

The Friday morning session was devoted chiefly to papers describing the flow properties of various polymer systems and the techniques used to measure these properties. During the afternoon papers presented discussed cooling time of glass fibers, relaxation spectra of high polymers, stress relaxation in glass, and the rheology of a liquid emerging from a capillary.

Topics considered Saturday morning included motion of plastic mass, creep of snow under various stress conditions, time dependence of mechanical breakdown in fiber bundles, tensile strength of GRS elastomers, and the experimental validity of Pao's hydrodynamic theory of viscoelastic flow.

During Saturday afternoon, papers were presented on the fracture of non-Newtonian fluids at high shear stresses, the occurance of dilatancy in concentrated suspensions, the flow of a Bingham plastic on an inclined plane, and the rheology of solutions of cellulose derivatives.

Following the technical session on Friday afternoon, results of the Society's election of new officers was announced as follows: president, J. H. Dillon, Textile Research Institute; vice president, J. H. Elliot, Hercules Powder Co.; secretary-treasurer, W. R. Willets, Titanium Pigment Corp.; and editor, R. D. Andrews, Dow Chemical Co. R. S. Marvin, National Bureau of Standards, and R. S. Rivlin, Brown University were elected members of the executive committee which also includes the present officers and the immediate past president, F. D. Dexter, Bakelite Co. The Society's 1958 annual meeting, it was announced, will be held November 5-7 at the Franklin Institute, Philadelphia, Pa.

SPE, National Committee

Formation of a committee headed by Jerome Formo, to develop plans for the formation of a plastics institute, has been announced by the Society of Plastics Engineers, Inc., Greenwich, Conn. The institute will set up an educational program; a library; and facilities for fundamental and developmental research. All segments of the industry are invited to participate.

ACS Division Elects Chairman

Arthur V. Tobolsky, Frick Chemical Laboratory, Princeton University, has been elected chairman of the American Chemical Society's polymer chemistry division for 1958. He succeeds Dr. Thomas G. Fox, Rohm and Haas Co., Philadelphia, Pa. Frank R. Mayo, Stanford Research Institute, Stanford, Calif., was named chairman-elect, and F. H. Winslow, Bell Telephone Laboratories, Murray Hill, N. J., was re-elected secretary-treasurer.

Reinforced Panel Council

Manufacturers of glass fiber-reinforced panels and their raw material suppliers have organized a council within the framework of the Society of the Plastics Industry, Inc., New York, N. Y. Purpose of the organization, whose first chairman is John S. Berkson, Alsynite Corp. of America, is to launch a program of industry research and consumer education with repect to flat and corrugated panels.

Mr. Berkson pointed out that the organization of this group, which has been meeting informally since 1952, reflects the reinforced plastics industry's conviction that building and construction comprise one of their most promising growth markets. During 1956 these applications accounted for 16% of the industry's total output, and a preliminary survey indicates that the volume will be even higher when the full 1957 reports are in.

Working in conjunction with the U. S. Commerce Dep't's National Bureau of Standards, the council was active in drawing up the regulations for commercial standard CS214-57 for glass fiber-reinforced polyester corrugated structural panels which went into effect last October. The standard, which defines both performance and appearance, covers two types of panels: general purpose, type I; and fire retardant, type II. Dimensional and quality requirements for the two are identical, but they differ in rate of burning and resistance to weathering elements.

Although council meetings are open to all interested parties, actual membership is restricted to companies actively engaged in the manufacture of reinforced plastics panels and to their material suppliers. The council will hold an annual meeting each April; regular meetings in August and December; and special meetings upon approval of two-thirds of the members.

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News of the Industry

Buys Polishing Plate Works

Monsanto Chemical Co.'s polishing plate manufacturing facilities at Springfield, Mass., have been purchased by Hawkridge Brothers Co., Boston, Mass., a metal warehousing firm. Hawkridge, who for some years has supplied the crude plate and distributed the finished product, now will handle the entire operation at a new plant location in or near the Boston area. Production is scheduled for July 1, 1958.

Acquires Eastern Franchise

Exclusive pre-impregnated resin sales and processing rights in the eastern United States have been granted to U. S. Polymeric Chemicals, Inc., Stamford, Conn., by American Reinforced Plastics, Los Angeles, Calif. The recently-consumated license agreement involves the latter firm's 91-LD, a phenolic high heat resin; and 37-9X, a new phenyl-silane copolymerized resin product.

This consolidation of efforts is expected to result in improved customer service and more adequate national coverage. Both companies will handle these products west of the Mississippi.

Produces Flexographic Inks

Following two years of laboratory development, Claremont Pigment Dispersion Corp., Roslyn Heights, N. Y., have introduced a universal flexo ink system for all packaging films. Tradenamed "Maxiprint", the inks have been well received by flexographic printers of cellophane and polyethylene. Present production facilities are geared to a yearly output of 200,000 gallons of ink, and engineering plans are complete for increasing this capacity to 400,000 gallons.

Polychromatic Synthesis!

Sandoz, Inc., New York, N. Y., a manufacturer of dyestuffs, textile chemicals, and pharmaceuticals, has acquired the stock of Fine Colors Co., Paterson, N. J. The latter firm, an organic pigment producer, will continue operations in a divisional status, under the direct supervision of Dr. J. W. Ackerman, who has been president of the company for the past 16 years.

Extensive research and testing facilities are planned for further improvement of pigments used in printing inks, textile printing, lacquers, paints, plastics, and allied products. Sales and service are under the direction of Max Gossweiler, division manager.

Forms Plastic Foam Division

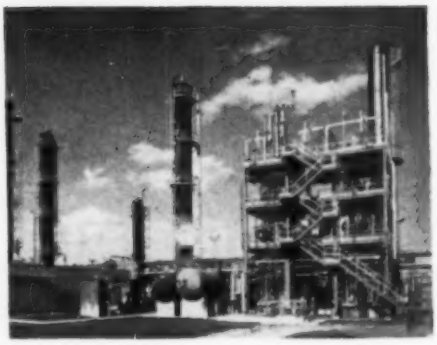
Burgeoning sales and expansion of production facilities at Marietta, O. and Hawthorne, Calif., has resulted in the formation of a plastic foam division by Dayton Rubber Co., Dayton, O. Headed by Harry Gerstin, vice president, the division is stepping up production of both flexible and solid urethanes. Basic urethane research and development will continue to be carried out at Freedlander Research and Development Laboratories, Hawthorne, Calif., while custom service and prototype design will be handled at the Dayton plant. All Dayton plastic foam products of polyester and polyether urethane will continue to be marketed under the tradename, Stafoam.

Cellulosics Forecast Bright

Reviewing the plastics activities of Eastman Chemical Products, Inc., Kingsport, Tenn., Spencer E. Palmer, first vice president, predicted a stable future and a continuing demand for cellulose acetate and cellulose acetate butyrate plastics. Substantiating his optimism, he pointed out that, "1957 production of cellulosics reached a new high . . . In point of fact, as recently as last summer demand for our Tenite acetate and Tenite butyrate was so heavy that we were almost obliged to fill orders on allocation."

"During the last four years, cellulosics production rose from 76,562,500 pounds in 1954 to 95,300,000 pounds in 1957," he continued. "We recently have seen cellulosics move into the sign field, where there is an enormous potential market for advertising signs that can be illuminated from the rear for long distance legibility. Butyrate particularly offers a unique combination of weatherability plus high surface gloss and an unlimited range of attractive colors that makes it superior for such uses."

Other points supporting Mr. Palmer's prediction include the recent introduction of cellulose propionate, and the increased use of cellulosics in appliance housings, women's shoe heels, color telephones, and decorative materials in automotive field.



Celanese's trimethylolpropane plant.

Produces Trimethylolpropane

A trimethylolpropane production facility, having an annual capacity in excess of 10-million pounds, has been placed onstream at Bishop, Tex., by Celanese Corp. of America. This material is an organic chemical intermediate used principally in the production of polyurethane foams and coatings, and alkyd resins.

The facility incorporates certain refinements in mass production techniques developed at the company's research laboratories at Clarkwood, Tex. The improved methods have permitted a price reduction for the chemical to 39¢ per pound, delivered in truck-load quantities. In addition to trimethylolpropane, the unit can deliver anhydro enneaheptitol, trimethylolethane, neopentylglycol, and other aldol products.

Consolidates Divisions

Consolidation of its R-B-H Dispersions and Textile Colors Divisions into a single unit, has been announced by Interchemical Corp., New York, N. Y. Known as the Color and Chemicals Division, the reorganized facility is headed by general manager William N. Davies, former president of textile colors.

Headquartered at Hawthorne, N. J., the new division was formed to make a more effective use of the company's production facilities. William J. Rothemich is general production manager, and Harold D. Craft is general sales manager.

Builds Pilot Plant

A chemical pilot plant, designed to facilitate process research and development, is being constructed adjacent to the general offices and laboratories of Richardson Co., Melrose Park, Ill. The firm currently operates six production units engaged in the manufacture of synthetic resins; asphaltic, rubber and plastic compositions; and in the fabrication of industrial products such as asphalt-based and thin-walled high-impact battery containers, copper-clad insulating boards for printed circuits, and molded laminate gears and pulleys.

Plans Two Production Units

Ground-breaking for two new plants at Norco, La., has been scheduled for early 1958 by Shell Chemical Corp., New York, N. Y. One of the units will engage in the manufacture of acrolein, while the other will use a hydrogen peroxide-acrolein catalytic oxidation to produce glycerine at rates up to 35-million pounds per year. Allyl chloride, currently used in the company's glycerine process, will be diverted for production of epichlorohydrin, epoxy resins, allylamines, and other derivatives.

Monomer Hybrids By Radiation

Wider use of radiation techniques in graft polymerization are foreseen by Dr. H. G. Hammon, Battelle Memorial Institute, Columbus, O. This method, a form of molecular cross-breeding achieved by exposing dissimilar monomers to a radioactive source, is a relatively new discovery.

"Graft polymerization by radiation," Dr. Hammon explains, "may prove to be exceptionally valuable. It offers . . . a means of chemically altering a preformed synthetic or natural polymer without changing its physical shape, and often without destroying many valuable properties."

Fission products or other artificially produced radioactive materials, as well as reactors, may be used to initaite graft polymerization. Other usable radiation includes X-rays, ultraviolet rays, and high energy particles from Van de Graaf generators, resonant transformers, and linear accelerators. In certain applications, selected monomers could be grafted to some of the newer synthetic fabrics to improve their receptiveness to dyes. Similar treatment of plastic films may improve their printability.

Commercial use of monomer hybrids will be expedited with the development of improved polymerization techniques, and the availability of less costly radiation sources. This method has proved economically feasible in a number of applications, and current industry trends point toward its wider acceptance.

Renames Chemical Division

Chemical operations of the Borden Co., New York, N. Y., which include 17 domestic plants and 11 located outside the U. S. have been consolidated under a new title: The Borden Chemical Co. Originally a supplier of plastics materials and many specialized products for the paper, textile, and paint industries, the company now is expanding its output to consumer products such as plastics garden hose and sprinklers; a high-nitrogen fertilizer; and a complete line of adhesives for the home handyman.

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Schedules Ziegler Polyethylene

A multi-million dollar linear polyethylene plant is being constructed at Bay City, Mich., by Dow Chemical Co., Midland, Mich. Scheduled for completion in October 1958, this facility will operate under a Ziegler license to produce the material in both powdered and granular form, and in natural white and other color formulations.

The product has had extensive pilot plant trials at Dow's Freeport, Tex. location, and the company plans a major operation in this field. Raw materials will be supplied by a wholly-owned subsidiary, Bay Refining Corp., Bay City, Mich.

Polyethylene Aqueduct

A polyethylene piping system at Ashtabula, O., joining the respective plants of Mallory-Sharon Metals Corp., and U. S. Industrial Chemicals Co., went into continuous operation recently to transport a saturated brine solution between the two operations. The brine, a by-product in the manufacture of Mallory's titanium and zirconium sponge, is piped to the sodium chloride reservoirs at U.S.I.'s electrolysis plant where it is broken down into its components and returned to the system.

Spanning a distance of 6,200 feet, the piping is fabricated from U.S.I.'s high-pressure polyethylene resin, Petrothene. It is made in 30-foot sections weighing 120 pounds, and is joined at the installation site. Unlike steel pipe which requires careful handling and adjustments in the trench, assembled sections as long as 300-feet were simply rolled into place with a single push. Inside diameter of the piping is 6.07 inches; wall thickness is greater than one inch; and the fluid is handled at temperatures from 80-90° F., and at pressures of 75 psig.

Lengths of polyethylene pipe are connected at Ashtabula, O. The resin is reinforced with carbon black, and joints are supported with steel back-up rings.

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Markets Wider Film

New production equipment at Minnesota Mining and Mfg. Co., St. Paul, Minn., has enabled the firm to market Scotchpak brand heat-sealable polyester film in widths up to 50 inches. The 31-inch increase over previously available films will enable converters to use Scotchpak in larger fabrications such as specialized bags, drum liners, and protective covering applications.

Adds Utility Wing

A 12,000 square foot wing, boosting total plant area to 32,000 square feet, has been added to existing facilities at Colorite Plastics of New Jersey, Inc., Paterson, N. J. The structure provides enlarged office space, and accommodates equipment to support the company's production of garden hose and custom extrusions.

Ups Polyethylene Production

Eastman Chemical Products, Inc., Kingspoint, Tenn., has announced the availability of a medium-density polyethylene, Tenite 100. The firm's plant at Longview, Tex., will be expanded by 50% to accommodate necessary production facilities. Total output by the end of 1958 is expected to reach 85-million pounds.

The Domesticated Atom

A linear accelerator, imparting particle energies up to 7 mev (million-electron-volts) has been adapted for sterilization

purposes through the joint efforts of Ethicon, Inc., Somerville, N. J., and High Voltage Engineering Corp., Cambridge, Mass. The unit incorporates two microwave power generators which work in conjunction with an electron gun, an eight-foot evacuated tube, and a beam scanner.

Electrons, riding on the crest of electromagnetic waves pulsating at 800 megacycles per second, accelerate down the tube until they reach velocities approaching the speed of light. At the bottom of the tube, they are picked up by the beam scanner which sprays the particles onto the product with uniform intensity.

At the Ethicon installation, the electron bombardment is used to sterilize packaged catgut sutures at rates from five to 10 dozen per minute. Under this method of sterilization, the catgut suffers a tensile strength loss of only 4-8%, as opposed to a 10-20% loss when heat treated. Since fission does not occur, there is no danger of the product becoming radioactive, although some momentary X-rays are produced when the beam strikes a solid object.

To determine if the sutures have received the proper sterilization dosage, a piece of PVC film is placed on each tray as it moves toward the electron beam. After the process, the film is baked, and the varying shades of color, which have been altered by the bombardment, are analyzed to determine the dosage received.

Prepares Polyester Prototypes

A process for the manufacture of prototypes, terminal strips, and small parts where low production runs do not justify expensive tooling, has been developed by Western Tool and Mfg. Co., Springfield, O. The firm uses a special polyester compound, IC-1218, made by Interchemical Corp., Newark, N. J.

Containing inert filler pigments and milled glass, the compound is either poured into an open mold for encapsulating, or ejected into a matched metal or plastic die. Western Tool reports that parts are equivalent in many respects to cast or molded phenolics. Molds and dies can be made from cast alloys, plastic, plaster, ceramics, and other materials.

Builds Office Facility

A $100,000 sales and adminstration building has been completed recently by Ferro Chemical Corp., New Bedford, O. Californian in style, the building incorporates glass, brick, and porcelain-enameled steel as structural materials. It was designed by the West Coast architectural firm of Richard J. Neutra and Robert E. Alexander.

Ferro Chemical Administration building.

Cheaper Adhesive Bonding

Cost of adhesive bonding is apt to decline by as much at 30-50% during the next two years, as a result of accelerated research and development activities by major producers, according to a forecast made by Clifford W. Brown, president, Narmco Resins & Coatings Co., Costa Mesa, Calif. Based on a three-month industry-wide survey, the forecast revealed that several major manufacturers are directing their efforts toward the development of structural adhesives that not only speed up the bonding process but also reduce its cost.

Introduced to the aircraft industry over 13 years ago, structural adhesives were developed to meet the need for a strong, light-weight, fastening material that could withstand high temperatures. In their early years, the adhesives answered so many vital aircraft requirements, that the cost of fabrication, which required constant inspection and skilled craftsmanship, was secondary.

According to Mr. Brown, " . . . the technology of adhesive bonding has progressed to the point where it is utilized by every major airframe fabricator. Adhesives have completely proven their capabilities and dependability, and now the emphasis is shifting toward the development of adhesives that cut production costs and can be applied by skilled workers under normal inspection and control conditions."

Development of cheaper bonding material and techniques should open the way for the adoption of structural adhesives by non-aircraft industries which, up to now, have been reluctant to use this method. Already one manufacturer has reduced fabrication costs on a primary aircraft component by more than 20% through the adoption of an improved adhesive which eliminates several production operations. A continuation of this trend should accelerate the use of structural adhesives in other applications.

Commences Ethylene Delivery

Phillips Chemical Co, Bartlesville, Okla., has gone on-stream with its recently-erected ethylene plant at Sweeny, Tex. This facility has a normal production capacity of 10-million pounds per year and, if required, can make annual product deliveries up to 290-million pounds. Designed and built by Stone & Webster Engineering Corp., New York, N. Y., the Sweeny plant discharges its product through a 70-mile conduit to support the firm's polyethylene operations at Pasadena, Tex.

Aerial view of Phillips' ethylene plant at Sweeny, Tex.

Stained Glass Ex Cathedra

Simulated stained glass windows, developed by Monsanto Chemical Co.'s plastics division, Springfield, Mass., have reached commercial fruition at the University of New Hampshire, Durham, N. H. The installation sandwiches 240 square feet of abstract painting into a 24-panel window wall located at Memorial Union Hall.

The painting was executed directly on a glass surface; covered by three layers of polyvinyl butyral; a layer of clear glass; and laminated by Guardian Glass Co., Detroit, Mich. Standard safety glass normally requires only one coating of interlayer, but in this case three were required to cushion the uneven surface of the art-work.

Artist John W. Hatch, an associate professor of art, said that laminated safety glass offers a new medium for artistic expression. Comparing this technique with the 14-step stained glass process, he pointed out that this method ". . . eliminates the need for cutting, waxing, firing, leading, and other steps in conventional processing which jump costs and sharply limit design possibilities."

Another application, involving decorative random patterns, had been announced by Monsanto earlier this year. Experimental designs were silk-screened to the plastic interlayer, following which the glass-plastic combination was laminated.

Builders Add Plastics Code

Code-writing committees of both the International Conference of Building Officials and the Southern Building Code Congress have incorporated the basic provisions of SPI's "Model Chapter on Plastics" into their respective building codes. Compiled through the joint efforts of the Society of the Plastics Industry, Inc., New York, N. Y., and the Manufacturing Chemists Association, Washington, D. C., the model chapter gives specifications for wall and roof panels, skylights, glazing, light-transmitting panels in monitors and sawtooth roofs, light-diffusing systems, partitions, exterior veneers, awnings, greenhouses, signs, and outdoor displays.

Reports On Acrylic Paint

Acrylic paints, first marketed in January 1953, have continued to perform extremely well after nearly five years of outdoor exposure in every climatic region in the U. S., according to a report prepared by Rohm & Haas Co., Philadelphia, Pa. The 70-page report tabulates, illustrates, and summarizes data obtained from some 3,000 test exposures begun in 1953.

An examination of the summary discloses that white acrylic paints exhibited excellent color retention in all exposures. This was found to be dependent on the chalking rate, which is the most important variable affecting the appearance of white exterior coatings based on acrylic emulsions. Paints exposed in the northern U. S. yield best results when formulated in a 70:30 proportion of non-chalking rutile titanium dioxide pigment to a free, or mild-chalking anatase titanium dioxide. In southern climates, a 90:10 ratio is used due to more severe sunshine and rain-fall conditions. These formulations gave constant, moderate chalking rates after 6-18 months exposure.

Dirt retention varies in nearly inverse proportion to the chalking rate, exposure conditions being constant. Erosion has not been an important factor with chalking at moderate or even at heavy rates, and acrylic formulations have proven themselves resistant to mold.

Application to masonry or asbestos-shingle surfaces gives better results than wood. Grain cracking is the most serious problem encountered, particularly where a bare wood has been painted. However, if the wood can be oil-primed, or has been painted previously with oil systems and is in good condition, satisfactory results can be obtained with top coats of acrylic paint. Adhesion to both chalked oil paint and glossy trim paint is good, but in areas which are sheltered from the weather, it is good practice to reduce surface gloss and remove dirt with sand paper, steel wool, or chemical solutions before applying the top coat.

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Rigid Vinyls In Construction

High impact rigid vinyl plastic may emerge as an important basic construction material in 1958, according to a year-end report issued by John R. Hoover, president of B. F. Goodrich Chemicals Co., Cleveland, O. Pointing out that during the past year high-impact Geon vinyl has been adapted for window tracks, and screen and storm door frames, he predicted that ". . . within two or three years structural, rigid vinyl will be as well known and accepted as vinyl flooring and upholstery are today."

Already in wide use in the chemical and process industries, vinyl piping has received the National Sanitation Foundation's approval for carrying drinking water, and more extensive applications are expected in domestic and industrial plumbing. Other areas where vinyl applications are proving satisfactory include wire insulations, protective coatings, and foams.

Organic Peroxide Catalysts

Organic peroxide, hydroperoxide, and metallic catalysts are being marketed through a newly-formed department at Nuodex Products Co., Elizabeth, N. J. Warehousing facilities are being set up at key locations across the country, and the operation will be provided with its own application and service laboratory. Catalyst sales will be handled by Joseph Palumbo.

Triples Product Output

A butadiene-styrene plant that will triple the capacity of its total manufacturing operations at Illiopolis, Ill., has been placed on stream by the Borden Co., New York, N. Y. Output of the automated facility will be devoted primarily to the company's Polyco 807, a low-odor emulsion used as a vehicle in Latex paint; and Polyco 2421, a binder used in pigmented clay coatings for paper.

Acquires Molding Division

Equipment and inventories of Fiberglass Reinforced Plastic Molding Division, American Hard Rubber Co., Akron, O., have been purchased by Molded Fiber Glass Co., Ashtabula, O. One of five affiliated companies, Molded Fiber Glass announces that this is its second major expansion since 1956.

Builds California Plant

A glass fiber manufacturing plant, costing in excess of $1-million, is being constructed by L.O.F. Glass Fibers Co., Toledo, O. Located at Corona, Calif., this facility is expected to commence operations in August 1958. It will be devoted to the manufacture, fabrication, and warehousing of the firm's complete line of insulation products, including its recently-introduced pipe insulation.

When the Corona plant is completed, the company intends to consolidate its entire West coast operations at the new location. Under the direction of John A. Morgan, vice president and general manager of the firm's Pacific coast division, the new plant will enclose an area of 105,000 square feet, and will employ about 300 persons. Company products such as acoustical ceiling, pipe and duct insulation, and roofing mat, are being used throughout the structure.

In Brief . . .

Archer-Daniels-Midland Co., Minneapolis, Minn., has opened a new branch sales office at 300 Mt. Lebanon Blvd., Pittsburgh 34, Pa. C. A. Aldag, formerly technical sales representative in Cincinnati, will manage the new office which will handle ADM's chemical products, marine oils, vinyl plasticizers, and industrial cereal products. Joseph A. Burns & Son will continue to act as agent for ADM resins, and E. E. Zimmerman will continue to handle ADM linseed and soybean oils.

Formica Corp., Cincinnati, O., has moved its New Jersey district office from Belleville to 18 N. Harrison St., East Orange.

Tri-Point Plastics, Inc., Albertson, N. Y., has appointed Samuel N. Stroum Co., Seattle, Wash., to handle sales of its plastics components in the Northwestern states.

Perma-Flex Industries, Ltd., has moved to 90 Brindgeland Ave., Toronto, Ont., Canada. The move, the second in the past five years, provides the company with additional floor space.

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Cut these new Synthetic Foams easier, faster, cheaper with . . . .

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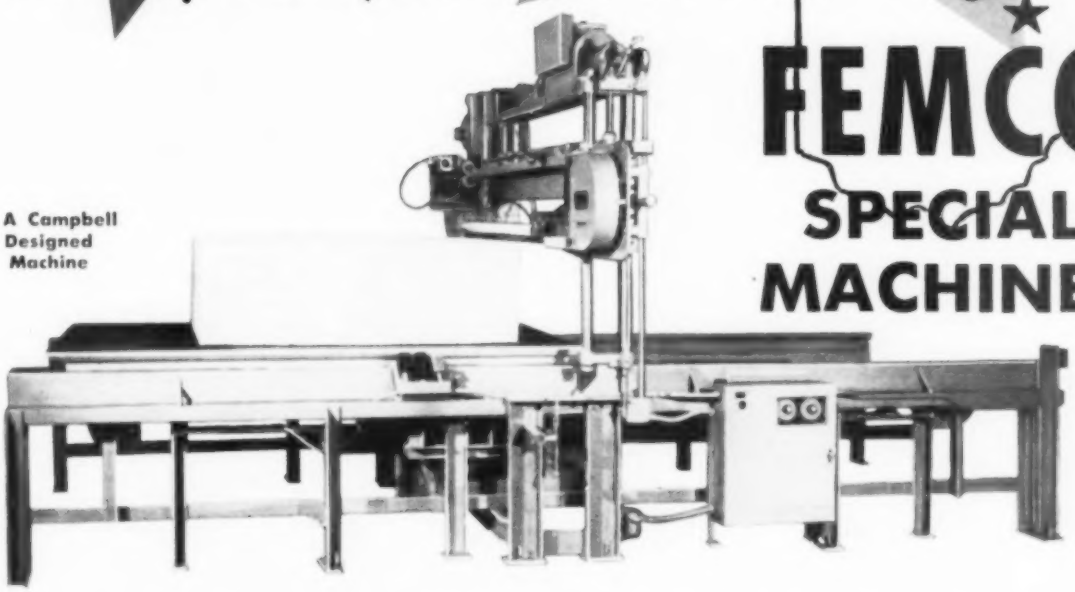

A Campbell Designed Machine

If you are working with any of the new synthetic foams, FEMCO has the machines that will help you do the job easier, faster and cheaper. The new 84" x 110" leveler and splitter, shown here, is FEMCO's latest achievement in the development of precision equipment for fabricating synthetic foams. It will automatically cut a 24" block of Polyether into 6" slabs or thinner to 1/16". One person, man or woman, can operate the machine.

THE WORLD'S LEADING PRODUCERS OF SYNTHETIC FOAMS USE FEMCO SPLITTING EQUIPMENT . . .

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- B. F. Goodrich Co.
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- Hewitt-Robins Inc.
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- NOPCO Chemical
- Dunlop Tire & Rubber Co.
- Hadley Bros. Uhl Co.
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Names in the News

Joseph C. Kay has retired as New England sales representative for Baker Castor Oil Co. He is succeeded by **Henry J. Sevin,** a recent addition to the sales staff.

F. Visser't Hooft, R. T. Browning, P. E. Sharts, and **M. T. Tiernan** have been elected to the board of directors of Wallace & Tiernan, Inc., Belleville, N. J. Mr. Hooft is vice president in charge of the Lucidol division, and has been associated with the company since 1925.

Thomas H. Wilson has been appointed Eastern regional manager of Polyfoam sales for the General Tire & Rubber Co. He has served as market research analyst since 1952.

Charles Y. Cain has been named administrative assistant to the general sales manager of Hooker Electrochemical Co.'s Durez Plastics division. He previously served as sales manager for Hetron polyester resins.

Dickran Yeghiayan has joined Glastic Corp., as chemical engineer in development and research. He is a former project engineer from Formica Corp.

J. B. Harlow has been appointed central division manager of Union Carbide Chemicals Co. He previously served as technical representative, and as district manager in Albany, Atlanta, and Detroit.

Jack MacVittle, former sales representative with St. Regis Paper Co., has joined Liberty Laminates of Brooklyn, N. Y. He will direct sales along the Eastern Seaboard.

William Rudko has been appointed plant manager at Rubber & Asbestos Corp.'s expanded facilities, Bloomfield, N. J. He was formerly plant manager for F. H. Maloney Co.

Allin C. Bears, former sales manager of Joanna Western Mills, Inc., has been named to fill that position with the Velvetex division of Velveray Corp., New York, N. Y. He replaces **John E. Williams,** who has retired after more than 20 years of service. Velveray manufactures vinyl wall coverings for homes and commercial institutions.

James Cunningham has been appointed manager of Witco Chemical Co., Canada, Ltd. He is a former New York salesman for the parent firm.

James S. McCoulloch has been appointed northeast district manager for Tube Turns Plastics, Inc. He will maintain headquarters in Riderwood, Md.

A. L. McMullen has been elected vice president in charge of production and a director of Seiberling Rubber Co. of Canada, Ltd. An 18-year employe of the parent company in Akron, he replaces **James W. Ansley,** who has resigned.

W. F. Tuley has been named to the new post of group manager, chemical development for U. S. Rubber's Naugatuck Chemical division. He formerly supervised rubber chemical and synthetic rubber research.

W. C. Quinby has been appointed assistant sales manager of flexible packaging materials for Bakelite Co. This includes both polyethylene and vinyls.

Donald W. Miller has been named sales engineer, Detroit office, for Wheelabrator Corp. Other new Detroit-area salesmen are **Fred H. Smith, Wayne W. Clements,** and **Andrew Joye.**

Stanley B. Mulder has been appointed Midwestern district manager of Plaskon industrial resin sales for Barrett division, Allied Chemical & Dye Corp. He is succeeded as Toledo area representative by **Thomas A. Bennett.**

Doran S. Weinstein has been elected president of Devoe & Raynolds Co., Inc., succeeding **Carl McFarlin, Sr.** He has served as executive vice president for four years, and has been a director for the last three.

George Kohlbacher has been named sales representative for industrial resins by the thermosetting division of Catalin Corp. of America. He will work out of the firm's Midwest sales office.

Gordon E. Chase has been named district sales manager for Manco Products, Inc., Melvindale, Mich. His territory covers Ohio, Indiana, New York, and western Pennsylvania.

John C. Geiss, manager of Archer-Daniels-Midland's branch office in St. Louis, has been named manager of the Cleveland office. **Louis H. Price** succeeds him. Former Cleveland manager, **Gerald C. Berry,** was recently transferred to the newly-opened Detroit office.

OBITUARY

C. Dudley Clawson

C. Dudley Clawson, 55, president of Ferro Corp., Cleveland, O., died February 4 while visiting a corporate subsidiary in Mexico City, Mex. A 27-year veteran of Ferro, Mr. Clawson had been president of the firm since 1947. He formerly held the post of vice president, and earlier had served two years as managing director of Ferro Enamel (Brazil) S. A.

Mr. Clawson was graduated from Ohio State University in 1925 with a degree in Ceramic Engineering. Active in civic and professional affairs, he was a member of the Cleveland Chamber of Commerce, the Cleveland Development Foundation, and for two years served as president of the Porcelain Enamel Institute, Washington, D. C. He is survived by his wife Inge B. Clawson, his mother, Grace Clawson, three sons, and four grandchildren.

Edwin R. Bartlett

Edwin R. Bartlett, 74, chairman of the finance committee and a director of Hooker Electrochemical Co., Niagara Falls, N. Y., died December 10, 1957 while at his winter home in Siesta Key, Fla.

A graduate of Dartmouth College, he settled in Niagara Falls in 1907 starting as a timekeeper with the Development and Funding Co., Hooker's early predecessor. In 1919 he was named works manager, and subsequent appointments included director, vice president and works manager, executive vice president, and in 1945, president. Retiring in October 1951, he continued as board chairman until 1955 when he was named director of the newly-created finance committee. Mr. Bartlett is survived by his wife, Katherine N. K. Bartlett, two sons, three daughters, and 11 grandchildren.

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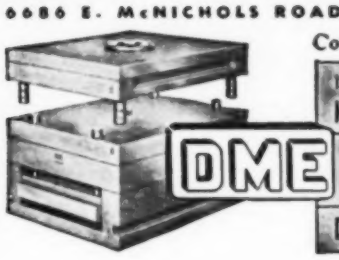

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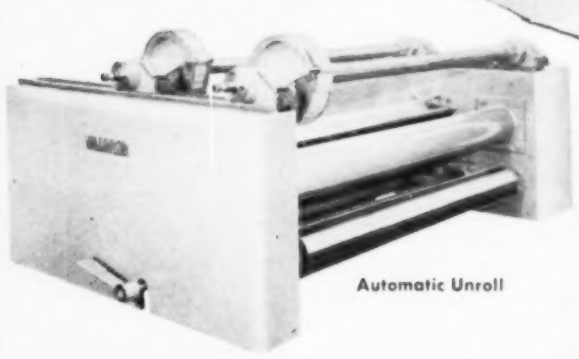

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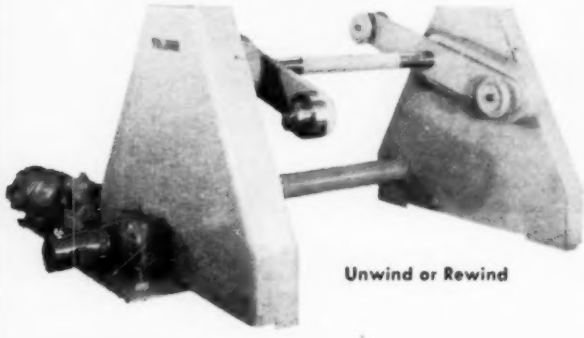

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News from Abroad

Acrylic Engraving Process

In a recently-patented Spanish process for the photo-chemical engraving of Plexiglas, the design is produced on the back of the object which then is covered with a coat of cellulose paint. This not only makes the engraved design or characters stand out better, but at the same time protects the surface. The process can be used in the production of all kinds of drawing and precision equipment (rulers, scales, components of measuring and control devices), as well as for artistic plates, commercial inscriptions and license plates.

By the photochemical method, a large number of figures, signs, or marks can be engraved in a small space. Thus, more than 100 perfectly legible characters can be imprinted on a surface of one square centimeter, and 720 lines (representing the 360 degrees and half-degrees of a circle) can be engraved in a circle having a diameter of 120 mm. (about 4.75 inches), something that is impossible to achieve with any other engraving system, it is claimed. The Plexiglas used has the advantage over anodized aluminum, for instance, of being lighter in weight, having greater rigidity for the same thickness, and, above all, gives characters that are much clearer.

Japanese Developments

The Toyo Koatsu Company has for some time been carrying on research on the production of a polyurea fiber, and reportedly has succeeded in developing such a fiber suitable for the production of fishing nets, as well as for tire cord and clothing. The new product has a specific gravity of 1.07; a Young's modulus of 300-600 kg./mm.; and a softening point of 230-240° C; a melting point of 240-250° C. The fiber is a polymer of monoethylene diamine urea, and the chief raw material is a dibasic acid obtainable from whale oil, rice bran oil, as well as from tall oil azelate, a product supplied by Grace Chemical Company. It is understood that the American firm plans a technical tie-up with Koatsu.

The Nihon Kokan K. K., a leading manufacturer of steel pipe, has entered an arrangement with Chemische Werke Huls, Germany, to make styrene monomer in Japan. This will be the third Japanese company producing styrene monomer, the two others being Mitsubishi-Monsanto and Asahi-Dow.

Toa Gosei Chemical Company is expected to begin building a new plant to produce PVC by the continuous polymerization method developed by the French firm, Saint-Gobain, Paris.

Production of acrylamide on a commercial scale is to be started in Japan for the first time by the Nitto Chemical Co. The material will be used to produce acrylonitrile fiber, adhesives, rubber compounding materials, and ingredients for treating leather and fiber.

Whale oil is said to be the raw material from which the Japan Ozone Company produces Nylon-6. The process is said to involve the derivation of oleic acid from fatty acid soap made from whale oil. The oleic acid is thermally decomposed to azeleinic acid, and then to azelein semi-aldehyde. Hydroxylamine is added to give the oxime, which is polymerized. The specific gravity of the polymer is reported to be 1.005, and melting range is 195-197° C.

A report is current that the China National Import Export Corp. is negotiating with the Japanese firm, Meiwa Sangyo Co. for the design and construction of a PVC compounding plant.

Plastics in Switzerland

The use of plastics in Switzerland has not been so widespread as in other more highly industrial countries, and the slow development of the industry has been attributed, in part, to that nation's general reluctance to replace conventional materials. A narrow domestic market and lack of raw material sources, cracking plants, and petrochemical industry, also have placed certain limitations of plastics output.

According to data compiled in 1955, Switzerland has 27 manufacturers of plastics and resin materials, 13 of which derive their products from basic chemicals. One manufacturer makes compounds from purchased resins, and three produce semi-finished rods, tubes, bars, and sheets. Total annual capacity for materials in powdered, granular, flake, or other primary forms is estimated at 20,000 metric tons. Trade sources estimate that 1955 production amounted to 15,000 tons, as compared to a consumption of 33,500 tons.

Domestic material production includes phenolic resins, urea and melamine resins, alkyds, aniline-formaldehyde, epoxy resins, polyesters, casein, PVC, polyvinyl acetate, methacrylic esters, cellulose nitrate, cellulose acetate, and polyamides. Polystyrene, polyethylene, silicones, and fluorocarbons are imported exclusively, the major suppliers being Germany, United States, United Kingdom, and the Netherlands.

The processing, fabricating, and finishing industries are adequately developed and supply most of the domestic demand for finished products. There are about 100 molders, 20 extruders, a few laminators, and about 25 fabricators and finishers.

Foreign branch factories have not been established, and outside investments in the industry are said to be insignificant. Several foreign companies do maintain sales or supervisory offices, but their primary purpose is to serve the industrial and trade centers of Europe.

Research is concentrated on processing and applications of acrylic resins and dispersions for the treatment of textiles, and on the improvement of applications for urea and melamine resins in laminated plastics. A recent Swiss contribution has been the development of a new polyamide, polycaprolactam, for use in the manufacture of film, pipe, and blown bottles.

There are no governmental decrees or restrictions governing the import and export of plastics materials. However, safety regulations prohibit the use of poisonous materials in wearing apparel, toys, and food packaging.

Puerto Rican Bootstrap

Master Records Syndicate, the fourth recording firm to start operations under the Commonwealth of Puerto Rico's "Operation Bootstrap" has commenced production in Rio Piedras, a suburb of San Juan. Headquartered in an 11,500 square-foot plant, the syndicate employs 50 people and plans to produce 750,000 long-playing, hi-fi records during its first year. Production will be marketed in continental U. S. through Remington Records, New York, N. Y.

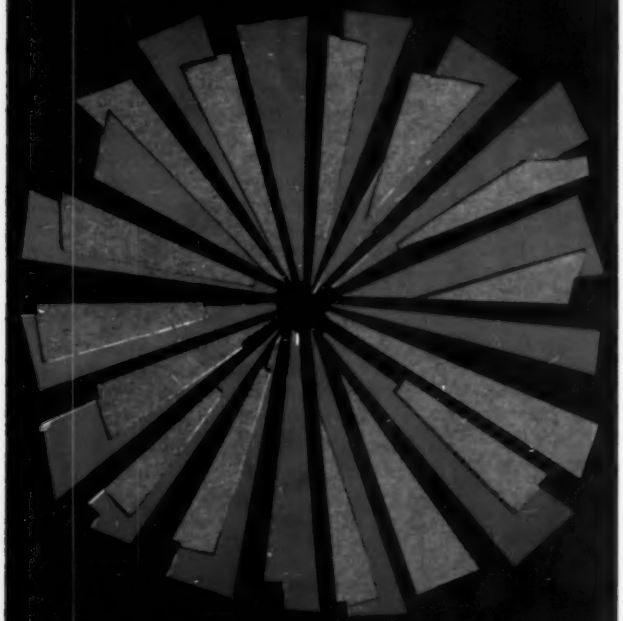
The firm uses a pre-form press to mold records from a plastic resin. Press operators are given 320 hours of on-the-job training, while record inspectors are trained for 160 hours.

The Commonwealth's "Operation Bootstrap" has attracted 500 U. S. industries to Puerto Rico through an industrial incentives program; whose services include assistance in employee training, a 10-year local tax exemption, and freedom from federal taxes. Its agency, the Economic Development Administration, maintains plant location counselling offices in New York City, Chicago, Miami, and Los Angeles.

Licenses British Firm

A license to manufacture Foamedge polyurethane products with a process developed by Sterling Alderfer Co., Akron, O., has been granted to Lintafoam Co., Loudwater, England. Under the agreement, the British firm will produce weather-stripping, garage-door bumper seals, grommets, refrigeration and air conditioning seals, vacuum cleaner and mop bumper strips, and a variety of other items for use at home and in the automotive field.

GENERAL COLOR COMPANY



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Makes Plastic Coated Steel

Four-foot wide steel plates, coated with a 0.014-inch layer of PVC, are being mass produced by John Summers & Sons Ltd., London, England. The plastic is adhered in the form of a sheet, to provide a safeguard against corrosion and to render the surface scratch proof. Adhesive qualities are reportedly excellent, and the plastic will not shrink under the conditions to which the steel is likely to be exposed.

British Plastics At Amsterdam

More than 100 applications of plastics materials were displayed by British industry at the International Plastic Fair held in Amsterdam, Holland, last November.

A dramatic demonstration was presented by Imperial Chemical Industries, Ltd., who used 11 transparent bands of polyethylene terephthalate to suspend a farm tractor in mid-air. The tractor weighed more than one ton, while the bands were 10-inches wide; 0.002-inch thick; and had a yield strength of 13,000 psi. Bristol Aircraft, Ltd., displayed a reinforced plastics rocket motor tube, and a pressure vessel used in aircraft and guided missiles. Various articles of protective clothing were featured by James North Export, Ltd., who had been invited by the British government to assist in the development of garments to protect workers from liquid propellants used in rocket engines.

Italian Firm Granted License

S. A. Luigi Pomini, Castellanza, Varese, Italy, has been granted a license for the manufacture and sale of a complete line of rubber processing equipment made by Farrel-Birmingham Co., Inc., Ansonia, Conn. Production will include Banbury mixers, mills, calenders, and extruders; all of which will be made in accordance with the licensor's design specifications.

Pomini is one of Italy's leading manufacturers of gears, gear drives, mining machinery, and rolling mills. Since 1949, the company has been engaged in the manufacture of rubber processing machinery under license from the British firm, David Bridge & Co., Ltd., whose operations have been in close association with those of Farrel-Birmingham for more than 40 years.

British Plastics Sales Up

Total sales of British plastics during 1957 were expected to top 400,000 tons, gross more than $280-million, and yield a 20% increase over 1956. Greatest advances were made by the thermoplastics group, which was led by polyethylene. Its output was expected to reach 55,000 tons. PVC has an expected 65,000 tons; and polystyrene, 30,000 tons.

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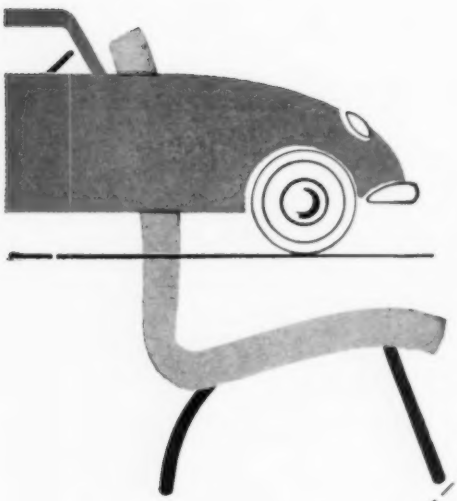

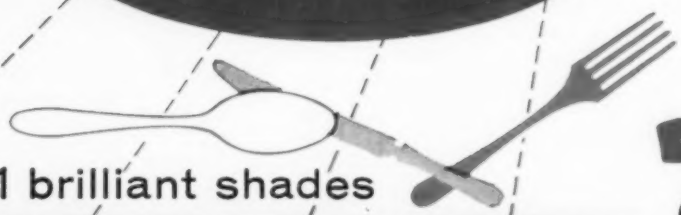

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New Materials

Write item numbers on Readers' Service Card to obtain more information.

Antiseptic Coating Material

An antiseptic coating material for such plastic items as telephone handsets, toilet seats, flush levers, banisters, sterile containers, door knobs, pen handles, and children's toys has been developed by White Chemical Co. Called Sterilon, the coating consists of a hydrophilic methanol-formaldehyde-nylon polymer containing 5-10% by weight of an active antiseptic.

The above-mentioned materials are soluble in isopropanol-water (70:30); the desirable solids content depending upon the method of application—about 3-4% solids for spraying, and 5-10% for painting or dipping. This coating is effective for varying lengths of time, depending upon usage and coating thickness. The company claims that a three-mil coating will render a telephone mouthpiece sterile for 1-2 years. Plastic materials usually require an acid or caustic dip as a pretreatment.

Readers' Service Item M-1

Vinyl-Acrylic Copolymer Resin

A coating emulsion developed especially for the paper industry, but expected to have many other protective coating applications, has been introduced by National Starch Products, Inc. Called Resyn 2203, the material is a vinyl-acrylic copolymer possessing excellent film flexibility and strength. Other characteristics include low viscosity, superior pigment-binding, excellent film clarity, and good mechanical stability.

The resin is reported to have a strong affinity for cellulose fibers, and coatings containing relatively small amounts are firmly anchored to the substrate. Dried films are virtually odorless. Typical properties are listed as follows:

Solids content, %	43
pH	6
Viscosity, Brookfield, cps	20
Particle size, microns	0.1
Mechanical stability	Good
Weight, lbs./gal.	8.9
Clarity	Water white
Film hardness, Sward Rocker	0
Water resistance	Good

Readers' Service Item M-2

Polymerization Intermediate

A new chemical, methallyl alcohol (2-methyl-2-propene-1-01), is presently available from Food Machinery & Chemical Corp.'s organic chemicals division for use in organic synthesis and in the resin and plastics field. It can be used as a reactive intermediate in the preparation of methallyl derivatives, or as a monomer in polymerization reactions.

Properties and specifications are reported as follows:

Molecular weight	72.1
Specific gravity	0.8515
Boiling point, °C	114.5
Appearance	Colorless liquid
Purity, Min. %	98
Weight, lbs./gal.	7.09-7.12
Distillation range, °C	110-116
Color, APHA max	20
Water content, max. %	1
Acidity as acetic acid, max. %	0.03
Flash point, °F	92

Readers' Service Item M-3

Color-Fast Organic Pigment

Farbwerke Hoechst AG., a leading West German chemical firm, has announced the availability, through Carbic Color & Chemical Co., Inc., of PV-Fast Red B. An organic pigment, it compares in fastness properties with the cadmium reds, while surpassing them in strength and brightness.

PV-Fast Red B is applicable to all plastics, and is expected to be especially valuable in coloring polyethylene since it is stable at temperatures up to 575° F. A 0.005% concentration in PVC (with ½% titanium dioxide) shows a 6-7 rating on fastness to light. Since this concentration is actually a pale pink, and eight is considered the top rating, it is readily seen that the pigment is highly light-fast.

The material is insoluble in plasticizers and solvents, and shows no blooming in PVC even at high temperatures. It is acid fast, and showed no bleeding after 15 hours at 212° F. Alkali fastness was reported to be very good.

Readers' Service Item M-4

Plastics Buffing Compound

A scratch-free buffing compound for removing burrs, flow marks, and other surface blemishes from molded plastic parts is presently available from Hanson-Van-Winkle-Munning Co. Designated PC-52, the material incorporates an anti-static ingredient which is deposited on the part as a thin film. This film is reportedly 100% compatible with most paints and lacquers, a feature which makes it especially useful for removing paint in vacuum plating operations.

PC-52 was formulated specifically for use with the softer thermoplastics, since they present the greater static problem. Of particular use for medium or heavy cuts, this material showed good results in experimentation work with the thermosetting phenolics. A built-in lubricant minimizes roll-over and burning problems encountered with the softer materials and, when used with thermosets, prevents the work-up and break through of mineral fillers.

The firm also manufactures PC-93 for high-color work on all types of plastics except nylon, and PC-19 designed for finishing work with acrylics. The materials are available in all standard bar sizes for manual and automatic applications.

Readers' Service Item M-5

Epoxy Tooling Resin Line

A complete line of epoxy industrial-tooling resins has been introduced by Emerson & Cuming, Inc. Designated Eccobild, the series includes two laminating resins, five casting resins, and two adhesives. Applications include the production of such auxiliary tools as models, patterns, checking fixtures, and positioning tools for assembly, drilling, routing, and the like.

Eccobild 121 is a general-purpose laminating resin featuring low cure-shrinkage. It cures at room temperature with Catalyst 209, and at elevated temperatures with Catalyst 211. With the latter, the cured laminate is said to offer improved properties at high temperatures. Viscosity at room temperature is reported at 10 cps., and shrinkage of a laminate containing 50% glass fibers is reported at 0.0002 in./in. Properties of cured laminates containing 181 glass cloth, Volan A surface treatment, and 50% resin are reported as follows:

Specific gravity	1.5
Flexural strength, psi.	45,000
Flexural modulus, psi.	2.3×10^6
Impact strength, Izod, ft.lbs./in. notch	40
Thermal expansion coefficient, °F.	7×10^{-6}

Eccobild 127 is an ultra high-temperature resin, clear in color, which will produce 500° F.-resistant laminates. Vacuum or pressure bag systems, wet lay-up, or matched metal molds can be used. Catalyst

New Materials (Cont'd.)

217 is recommended for use with this resin, and pot life is estimated at one week. About 3% Filler BA can be added to prevent "run-off" during cure. Properties for a cured (400° F.) laminate containing 181 glass cloth with a Volan A surface treatment are reported as follows:

Flexural strength, psi. at	
70° F.	76,000
At 300° F.	54,000
Flexural modulus, psi. at	
70° F.	3.9×10^6
At 300° F.	3.5×10^6
Coefficient of thermal expansion, °F.	5×10^{-6}

Eccobild 314 is a high impact-strength adhesive and sealant, paste type, which can be cured to a rigid, semi-rigid, or flexible compound. Used for general purpose cementing, it also can be employed as a filler, sealant, or patching compound. It cures completely at room temperature, but heat can be used to hasten cure. A two-component system, the proportions used determine the flexibility or rigidity. Average properties are reported as follows:

Temperature range for use, °F.	—70 to 300
Bond strength in shear, psi.	3,200
After 30-day H_2O soak, psi.	2,900
Flexural strength, psi.	5,500
Impact strength, Izod, ft.lbs./in. notch	9

Eccobild 318 is a one-component high temperature adhesive which is simply heated to effect cure. Containing 100% solids, it does not flow during cure nor does it show any dimensional changes after cure. Usual applications are as a general-purpose patching compound, pit, or crack filler. After cure, it can be filed or sanded. Properties are given as follows:

Temperature range for use, °F.	—70 to 500
Bond shear strength, 1-in. overlap of aluminum plate, psi.:	
At room temperature	4,800
At —70° F.	2,800
At 200° F.	2,200
Flexural strength, psi.	16,200

Eccobild 420 is an easily-poured, dimensionally stable casting resin, aluminum in color, which can be cured at room- or elevated temperatures. It can be cast in metal, wood, plaster, or molds made from itself. Heat conductivity is excellent, and shrinkage is essentially zero. Catalyst 209 is used for room temperature cure; Catalyst 211 for elevated-temperature cure, which gives better high-temperature properties and allows for longer pot life. Properties are as follows:

Temperature range for use, °F.	—65 to 300
Tensile strength, psi.	9,000
Compressive strength, psi.	20,000
Flexural strength, psi.	15,000
Flexural modulus, psi.	0.65×10^6
Impact strength, Izod, ft.lbs./in. notch	0.5
Thermal expansion coefficient per °F.	10×10^{-6}
Water absorption, 7 days, %	0.1
Thermal conductivity, Btu./hr./ft²/ft./°F.	0.85

Eccobild 450 is a non-setting, dimensionally-stable casting resin featured by easy pouring, excellent heat conductivity, and zero shrinkage of the cured casting. General features are similar to Eccobild 420, with the following exceptions:

Viscosity, cps. at 70° F.	2,000
At 100° F.	100
Tensile strength, psi.	8,000
Compressive strength, psi.	11,900
Impact strength, Izod, ft.lbs./in. notch	1

Eccobild 470 is an ultra high-temperature casting resin which can be used continuously at temperatures of 500° F., intermittently at 600° F. Shrinkage during cure is extremely small, and dimensional stability in use is exceptional. Finished castings are easily machined. Catalyst 217 is used, and the mixture is heated to 170° F., at which point pot life is eight hours. Properties obtained on post-cured samples are reported as follows:

Tensile strength, psi.	7,000
Tensile modulus, psi.	1.4×10^6
Compressive strength, psi.	23,000
Compressive modulus, psi.	0.7×10^6
Flexural strength, psi.	15,000
Impact strength, Izod, ft.lbs./in. notch	0.5
Thermal expansion coefficient per °F.	9×10^{-6}
Shrinkage during cure, in./in.	0.0005

Eccobild 430 is a casting resin of controlled flexibility or hardness, and is especially valuable for tools which will be subjected to shock or impact. A two-component system, it is useful also as a

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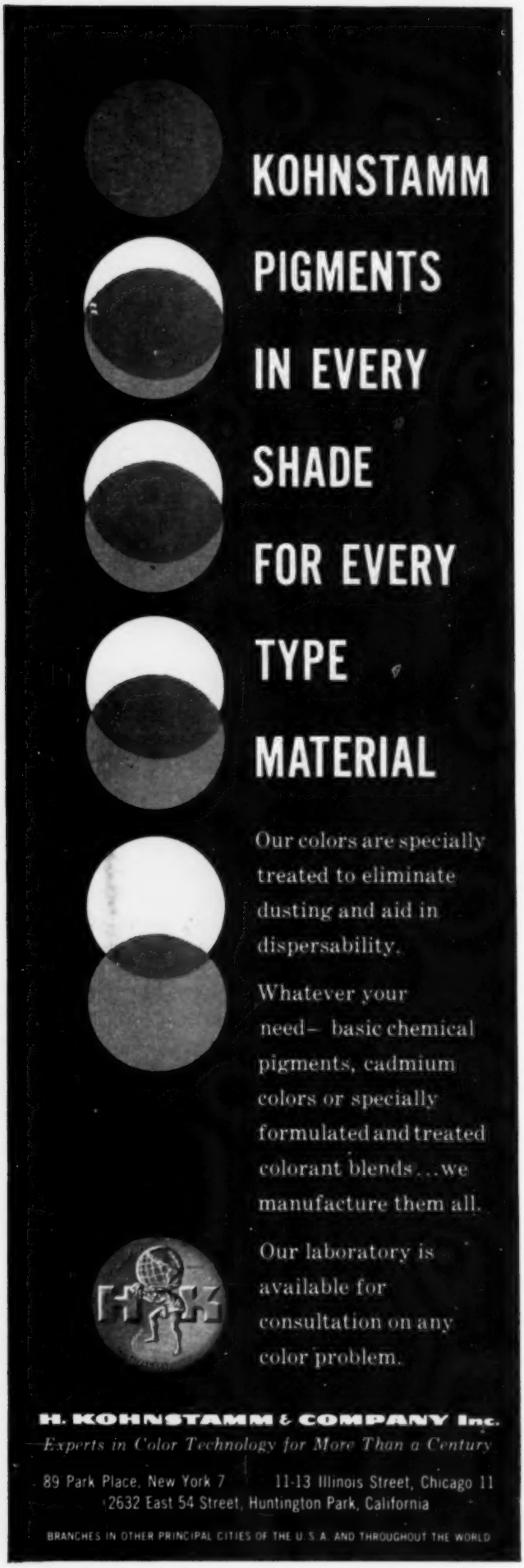
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face coat because of its impact strength. Pot life is short, especially at elevated temperatures. Exact properties are dependent upon the formulation used; however, average properties are as follows:

Specific gravity	1.2
Flexural strength, psi.	7,000
Flexural modulus, psi.	1.1×10^5
Impact strength, Izod, ft.lbs./in. notch	9
Temperature use range, °F.	—94 to 302

Eccobild 490 is a tooling resin with dimensional stability comparable to the best tooling resins, yet it weighs less than half that of other materials. It has an extremely low shrinkage during cure and, once cured, is useable to 350° F. A cubic foot of the cured resin weighs less than 45 pounds. Properties are reported below:

Specific gravity	0.7
Density, lbs./cu.ft.	44
Flexural strength, psi.	4,200
Coefficient of linear expansion, in./in./°F.	10×10^{-6}
Thermal conductivity, Btu./sq./ft./hr./°F./in.	0.8

Another interesting product recently introduced by Emerson & Cuming is Eccostrip 57, a solvent for cured epoxides, polysulfides, polyesters, and silicones. A non-flammable, free-flowing pink liquid, it can be used also to remove paint and a wide range of surface coatings. To remove embedded items, the casting is covered with Eccostrip 57 in a covered metal container and allowed to stand overnight. This process is repeated for several days until the object is completely clean.

Readers' Service Item M-6

Sisal-Filled Impact Phenolic

A sisal-filled, two-stage phenolic molding compound in nodular form has been introduced by the Durez Plastics division of Hooker Electrochemical Co. Called Durez 18683, the material is designed for applications which require a long flow, good water resistance, and a glossy finish under low pressure molding conditions.

The low-cost material is black in color, and can be molded at the same pressures as general-purpose phenolics, using standard dies. It can be preformed automatically in horizontal preforming machines, and curing time is the same as for the regular materials.

Property data are reported as follows:

Bulk factor	3.7
Density, gm./cc.	0.38
Plasticity	22
Specific gravity	1.42
Molding shrinkage, in./in.	0.006
Waster absorption, %	0.9
Impact strength, Izod, ft.lbs./in.	1.2
Flexural strength, psi.	8,500
Tensils strength, psi.	5,500
Compressive strength, psi.	25,000
Heat distortion point, °F	270
Modulus of elasticity in tension x 10^6	1.3
Hardness, Rockwell M.	105
Ash content, %	20

Readers' Service Item M-7

New Equipment

Write item numbers on Readers' Service Card to obtain more information.

H-P-M Model 200-H-6/8 Injection Machine

Hi-Speed Injection Machine

A high-speed injection molding machine, said to be the fastest 6/8 ounce unit on the market today, is available from The Hydraulic Press Co., Div. of Koehring Co. Designated the Model 200-H-6/8, the machine is suited for all types of difficult custom molding, and high-speed jobs required in the packaging industry. At full clamp stroke with maximum tonnage, 720 cycles per hour are possible; with reduced stroke, as many as 900 cycles.

The new 200-ton unit with a 30-hp. motor features a full hydraulic clamp with a 15-inch stroke and 25-inch daylight. The clamp adjusts automatically for different mold thicknesses, thereby cutting mold set-up time to a minimum. Any part of the total ram stroke can be used, and the clamp controls are centralized. Movable cams provide for easy adjustment of stroke, daylight, slow-close for die contact, slow break-away, and ejection stroke. Independent clamp and injection circuits permit simultaneous traversing of both clamp and injection rams, thus eliminating the dead-time inherent in machines using a single circuit with a diverting system.

The injection circuit features controls for "prepacking" shots of eight ounces or more; flow control for plunger slow-down; dual pressure adjustment for lower holding pressure after the mold is filled; and automatic unloading of the injection pump, giving savings in horsepower, water, and longer pump life. A differential circuit allows rapid pre-positioning of the injector plunger at the start of the cycle. Clamp pressure then actuates the injection plunger for the "shot." The entire injection assembly, actuated hydraulically, is mounted on phenolic shoes on guided ways. Hydraulic pressure holds the nozzle on the sprue bushing, and provides easy retraction of the entire injection unit for purging or quick removal of the heating chamber.

A separate pilot circuit has external pressure and pilot lines to each individual valve. This separate circuit insures uniform shift of valves, and prevents excessive wear because of surge shocks common to internal pilot systems. Large 26 x 26-inch platens provide space to mount mold bases up to 15 by 26 inches, either vertically or horizontally. The 15½-inch space between the tie rods and the large area below the die space allow adequate room for automatic drop-out of molded parts. The knock-out bar exerts 15 tons of pressure, has a four-inch stroke, and can be moved easily for either a horizontal or vertical knock-out pattern. Automatic clamp slow-down is provided before bar contact to prevent damage to ejected parts.

The forged torpedo of the high-capacity heating chamber is of one-piece construction, permitting placement of heating bands directly on the torpedo section for better plasticizing of the molding material. The over-head oil tank incorporates an oil bath air cleaner, oil level gage, and thermometer. Hydraulic oil is located over the pumps and main cylinder to allow positive gravity pre-fill action, and prevent possible contamination of the oil with water or other foreign matter.

The electric control panel houses the main electrical controls, including motor starter, pyrometers, timers, relays, and transformers. The electrical circuit between machine and panel is wired as-received, and the only connection needed to place the machine in operation is the main power supply to the panel. The panel allows for easy access to timers and temperature controls, and is mounted on its own base separate from the machine. Manifold sub-plate mounted valves reduce the number of hydraulic pipe lines, and all hydraulic components are mounted in the open for easy accessibility.

Other specifications for the machine are given in the following tabulation:

Material injected per cycle, oz.	6
By "prepacking" or double-stroke feed	8
Material injected per shot, cu.in., max.	10
Per minute, cu.in.	675
Plasticizing capacity, lbs./hr.	80
Material hopper capacity, lbs.	80
Injection pressure on material, psi.	20,000
Injection plunger diameter, in.	2.5
Stroke, in.	10
Speeds, in./min.: Max. adjustable	138
Fast return	285
Fast advance	270
Mold break-away & ejection pressure, tons	15
Ejector pressure capacity, tons	15
Max. ejector stroke, in.	4
Clearance between tie rods, in.	15½ x 15½
Min. mold thickness, in.: Without spacer	10
With four-inch spacer	6
Max. ram travel, in.	15
Clamp travel speeds, in./min.:	
Closing fast	840
Slow	60
Opening fast	800
Slow	115
Ejecting	115

Plasticizing and injection capacities are limited by shot size, mold design, etc. All injection capacities shown above are for general-purpose polystyrene, and will be greater for thermoplastic materials hav-

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ing higher specific gravities.

Optional extras for the machine include automatic cycle controls with cycle-open timer; low pressure mold closing protection; nylon nozzle; proportional temperature controlled for nozzle; weigh feeder with 100-pound stainless steel hopper; automatic oil temperature control valve; power pack unit with additional 20-hp. system for injection speeds up to 1,075 cubic inches per minute; plus special hydraulic and electrical sequencing.

Readers' Service Item E-1

Markem Model 45H plastics imprinter.

Instant-Dry Marking Machine

A machine for stamping instant-drying, non-smearing imprints on plastic bags, envelopes, labels, and box wraps has been introduced by Markem Machinery Co. Designated Model 45H, the unit operates at speeds up to 90 per minute.

The unit employs the new Markem Thermomark process which, used in conjunction with Touchdry marking compound, imprints with a thermostatically-controlled printing head. Touchdry compound, normally solid, is melted before application. It solves the "drying out" problem inherent in all conventional cold-marking inks. Waste and spillage are eliminated.

The printing head is equipped to use Markem masterplates, type bars, or Thermomark rubber plates. Maximum imprint area with masterplate or type bars is $6\frac{9}{16}$ by $2\frac{5}{16}$ inches; with rubber plates it is $6\frac{9}{16}$ by $2\frac{7}{16}$ inches. Work-holding fixtures are interchanged easily. Bench-mounted, the machine measures 21 by 26 inches and stands 31 inches high.

Readers' Service Item E-2

Two-Roll Laboratory Mill

A two-roll, six- by 13-inch laboratory mill with four-inch diameter journal necks has been introduced by the JMC division of Johnson Machinery Co. Overall features include hardened and ground steel rolls, cast steel top frames, forced feed lubrication, micrometric roll adjustment, calibrated indicators, full-bronze liners, cut-tooth steel connecting gears,

JMC six- by 13-inch lab mill.

7½-hp. geared motor, knee-type safety controls, and heavy-gage steel cabinet.

The rolls are cored and fitted with siphon-type rotary joints for steam/water circulation. Chrome-plated rolls are optional at extra cost. The top frames are machined to close tolerances, and the journal-box bearings have provision for water cooling. All other bearings are of the roller- or ball-bearing, anti-friction type. The connecting gears are provided with a 1.4:1 friction ratio, though other ratios can be supplied at no extra cost.

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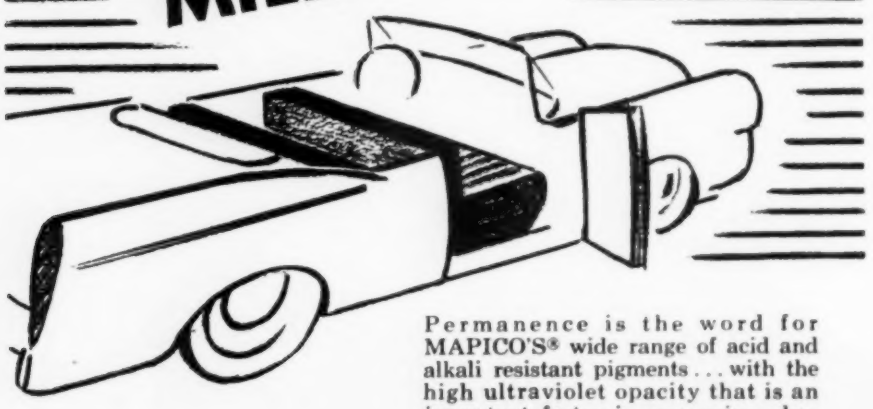

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Readers' Service Item E-3

Contour Scriber assures exact vinyl tile fit.

Do-It-Yourself Contour Tool

A simple, low-cost Contour Scriber has been placed on the market by Charles Machine Co. Ideally suited for the "Do-It-Yourselfer," the Scriber enables anyone to do a professional job of fitting vinyl or rubber tile, linoleum, plastics, wood, or sheet metal.

A row of loose tiles is placed directly over the last row of installed tiles. The Contour Scriber is adjusted to the exact width of the tile being used, held to the wall, and the marking end draws a line on the tile as the entire Scriber is drawn along the baseboard. A variation of the same technique can be used to make cut-outs for pipes and other projections.

Parts of the Scriber include a wall guide, line guide, adjusting screws, extension bar, adjustable pointer blade, and pencil holder. Used as a bench tool, it marks circles or scrolls from 1-25 inches in diameter and follows irregular lines and surfaces.

Readers' Service Item E-4

Table Model Vacuum Former

A table model vacuum forming machine weighing but 35 pounds has been introduced by Plast-O-Craft Co., Inc. Called the Test-Vac 81, the unit has a nine- by nine-inch forming area and a 24- by 30-inch formica surfaced base. It draws to a four-inch depth, and its movable frame is adapted to straight as well as drape forming.

Bench-model vacuum forming machine.

Test-Vac 81 is wired for 110 volts, and uses an infrared heat source with a chrome steel reflector. It has been used successfully with polystyrene, acetate, butyrate, extruded acrylics, vinyl, and polyethylene. Processors expected to have use for the machine are package designers, model and mold makers, development departments of vacuum formers, hardware manufacturers, and any firms engaged in blister, contour, or skin-formed packaging.

Readers' Service Item E-5

Electron Bombarding Assembly

An assembly for treating polyethylene film electronically as it leaves the extruder has been introduced by Aetna Electronic Corp. It consists of 20 tabular electrodes sheathed in a permanent dielectric jacket, and is mountable in such a way that the electrodes enclose 180° of the film undergoing treatment. The standard unit is deisgned for use on an eight-inch diameter treating roll with film widths up to 42 inches. Larger diameter electrodes are employed for film widths of 42-66 inches.

The power input for the unit is 115 volts, 50/60 cycles, single phase. Approximately one KVA is required for 32-inch electrodes. A proportionately higher power input is required for the unit using the wider electrodes.

Spacing between the electrodes and the roll is approximately 1/16-inch. The standard unit handles lay-flat tubing at speeds up to 100 feet per minute. With respect to positioning, the treating roll is located between the pinch rolls and the rewind, and the power unit can be located in any accessible position within 10 feet of the electrode assembly.

The treating roll is all metal, and does not require a dielectric covering. Stationary electrodes automatically lift the current to a safe value which will not burn through the film.

Readers' Service Item E-6

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Plastics Applications

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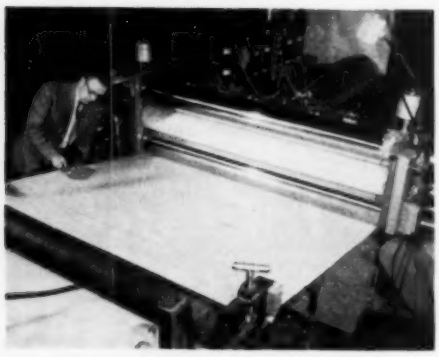


A 75-inch wide sheet extrusion is checked for gage accuracy.

Extrudes 75-Inch Wide Sheet

A sheet extruder that delivers high impact polystyrene and polyethylene in material widths up to 75 inches has been put into operation by Kal Plastics, Inc., Beaverton, Mich. The unit has a maximum output of 450 pounds per hour, and will handle sheet thicknesses ranging from .010-.250 inch while maintaining tolerances of ±.001-inch. The 75-inch material is being sold as roll stock up to 60-gage, and heavier gages are available as cut stock up to 72 inches.

Readers' Service Item P-1

Eye Glass Protector Mask

A special face piece for gas masks featuring a built-in spectacles frame has been introduced by Acme Protection Equipment Co. Called the Acme No. 6, the face piece incorporates a support bracket that mounts a spectacles frame for holding the wearer's own prescription lenses. This assures perfect fit around the temples and ears, eliminating the usual leakage encountered when standard masks are worn over standard glasses.

Acme gas mask for wearers of glasses.

Large outer lenses of optical quality Plexiglas are shaped to provide adequate space for wearing glasses comfortably. To prevent distortion, Acme polishes the molds several times to assure an optically flat surface. Controlled pressures, time, and temperatures are required along with careful attention to mold release methods.

Readers' Service Item P-2

Open-Cell Vinyl Foam

An open (interconnecting)-cell vinyl foam adapted for electronic sealing to cloth or vinyl sheeting has been placed on the market by Foam King, Inc. Called Foam King 738-14, the foam is said to have such desirable properties as low plasticizer content, low lubrication (resistance to plate out on dies), excellent resilience, uniform cell structure, fire retardance, and freedom from odor.

The foam is available as slab or sheet stock in densities of 6.5-7 pounds per cubic foot. A number of heat- and light-stabilized pastel colors can be obtained, and thicknesses range upwards from 1/16-inch. Tensile strength is 40 psi., and elongation is 75%. A load of one psi. is required to produce a 25% deflection. Suggested applications include place mats, padded clothing, belts, handbags, quilting, novelty items, and the like.

Readers' Service Item P-3

Clear Polyethylene Film Wrap

A new development which promises to have considerable impact on the packaging industry has just been announced by Phillips Chemical Co. Using a T-die/water bath technique, Phillips extrudes Marlex 50 polyethylene into 0.4-0.6 mil film. Extrusion rate is 175 feet per minute, and the close positioning of the die lips to the water bath (within ¼-inch) allows rapid quenching. This last mentioned factor is thought to be responsible for the high degree of clarity obtained with the new film.

Marlex 50 extruded to ½-mil film overwrap.

Intended primarily as an overwrap, the film should be able to compete costwise with cellophane. Phillips plans to release the process to film extruders, and will not enter the film-producing market. Tensile strength, machine direction, is three times that of the transverse direction; a factor which should make it ideal for the cigarette-type tear pack. Marlex 50 film can be heat sealed and printed, using conventional methods. The stretchy nature of conventional polyethylenes, as opposed to the high density materials, would dictate against their use in this type of application.

Properties of the film and extrusion conditions are outlined below:

Melt index	4.41
Tensile strength, psi., machine direction	12,210
Transverse direction	4,632
Elongation, %, machine direction	118
Transverse direction	8
Tear strength, gms./mil, machine direction	408
Transverse direction	791
Haze, %	6
"See-Through" rating	Infinite
Screw speed, rpm.	35
Motor load, D.C. amps.	10
Screw conditions	Neutral
Cylinder temperatures, °F., rear zone	480
Middle zone	490
Front zone	500
Adapter temperature, °F.	500
Stock temperature, °F.	475
Die temperature, °F.	500
Die opening, in.	0.02
Water bath temperature, °F.	145

Readers' Service Item P-4

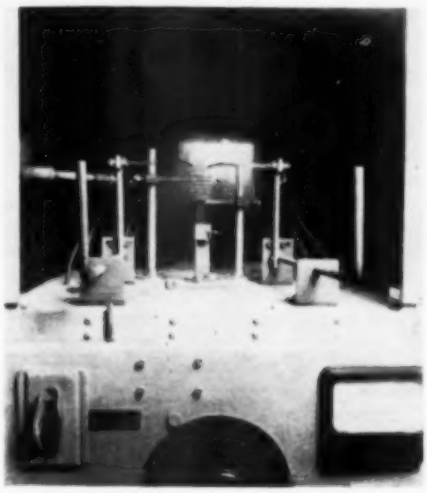
Flame Retardant Laminate

A flame-retardant, glass fabric-base/

Plastics Applications (Cont'd.)

epoxy laminate has been introduced by Continental-Diamond Fibre Corp. Designated Grade GB-28EFR, the laminate will not continue to burn when removed from a direct source of flame. It can be used continuously at temperatures to 300° F., and also possesses extremely high strength and outstanding electrical properties.

Flame resistance was tested in accordance with the new National Electrical Manufacturers Association switchgear requirements, which are a modification of method 2023.2 of Federal Specification L-P-406B. The laminate is available in sheets ranging from 0.01-1.0 inch in thickness, and in two forms: plain, for



CDF epoxy-glass laminate being tested for flame resistance.

power requirements; and metal clad, for printed circuitry.

Mechanical and electrical properties are reported for ⅛-inch thick specimens, as follows:

Flexural strength, psi., lengthwise	6,800
Crosswise	6,400
Flexural modulus, psi., lengthwise	5,000,000
Crosswise	3,500,000
Tensile strength, psi., lengthwise	4,600
Crosswise	4,200
Tensile modulus, psi., lengthwise	3,000,000
Crosswise	2,800,000
Impact strength, Izod, ft.lbs./in. notch, edgewise	12-18
Compression strength, flatwise, psi.	70,000
Shear strength, Johnson, flatwise, psi.	2,600
Dielectric strength in oil, step-by-step, parallel to laminations, kilovolts	35-65
Short time, perpendicular to laminations, volts/mil	550
Dissipation factor, 60 cycles	0.01-0.015
Dielectric constant, 60 cycles	4.58-5.35
Loss factor, 60 cycles	0.046-0.08
Dissipation factor, cycles x 10^6	0.031-0.038
Dielectric constant, cycles x 10^6	4.95-5.28
Loss factor x 10^6	0.15-02
Arc resistance, sec.	180
Insulation resistance, megohms	100,000
Volume resistivity, megohms x 10^7	1.8
Surface resistance, megohms	200,000

Readers' Service Item P-5

Rigid Unplasticized PVC Fan

An exhaust fan for removing corrosive air, fumes, and gases is available from Industrial Plastic Fabricators, Inc. Called the PVC Tubeaxial Fan, its essential parts are fabricated from rigid, unplasticized PVC. Structural parts, such as the motor and fan mountings, are steel with an acid-proof coating.

The PVC inner housing, welded tightly to the outer housing, protects the stainless steel drive shaft and bearings from the corrosive fumes. At one end of the inner housing, however, the drive shaft must protrude out through the casing to drive and support the fan or semi-pressure wheel. A Teflon packing gland is used to seal the area where the shaft is located, thus insuring an air-tight inner housing. A PVC sleeve fits over the projecting drive shaft on through the packing gland to the front main bearing.

The mechanism which secures the wheel to the drive shaft is stainless steel, protected and sealed with a removable spinner cap. This cap also helps to deflect the air with an even flow to the blades. Standard models have eight PVC air-foil blades.

IPF exhaust fan features unplasticized PVC parts.

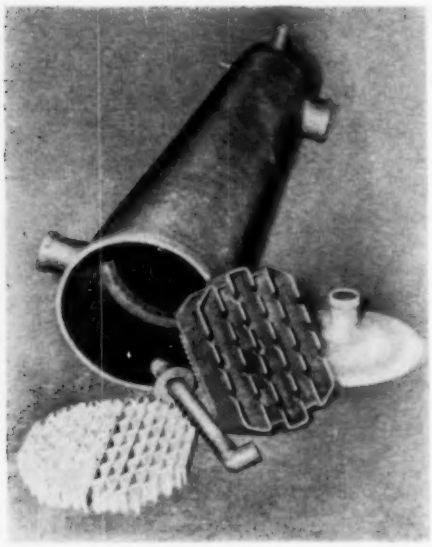
Readers' Service Item P-6

Reinforced Plastic Towers

An absorption tower with grid plate, distribution plate, trough, feed pipes, and cap have been constructed entirely of glass-reinforced polyester resins by Haveg Industries, Inc. This particular construction was designed to resist the corrosive action of hydrochloric acid, other strong oxidizing acids, hypochlorites, salts, weak alkalis and many solvents. The tower can be operated continuously at 212° F., and temperatures to 265° F. are not considered prohibitive for intermittent service.

In this plant making plastic printing plates, each press *has its own Speedylectric steam boiler.* Each press is independent of the others, and each gets steam at the right temperature and pressure. There is no big boiler to waste power when only one or two presses are needed, and it takes only minutes to bring a press up to temperature for a rush order.

For every plastic molding operation, a Speedylectric steam generator is the ideal answer. Using the most economical method of generating steam electrically, its design eliminates low-water hazard and practically removes the need for attendance. Maintenance is nil, and there's no risk of fire or explosion. Sizes from 2 to 60 Bhp, 15 to 300 psi and higher. Requires 220, 440, or 550 v A.C. UL listed, ASME Code. For more information write Pantex Mfg. Corp., Box 660AU, Pawtucket 4, Rhode Island.



Haveg reinforced-plastic absorption tower and parts.

Haveg formerly fabricated absorption towers in asbestos-filled phenolic; however, the new polyester variety is lighter and less expensive. It is equally serviceable under less severe working conditions. The company manufactures all types of chemical processing towers from phenolics, furans, epoxies, polyesters, and rigid PVC.

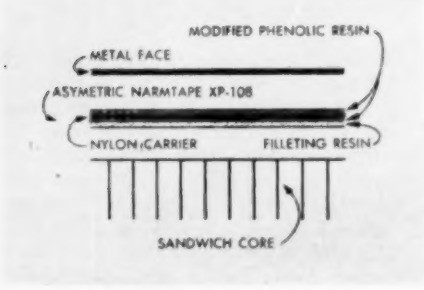
Readers' Service Item P-7

Core-Priming Adhesive

An "asymmetric" structural adhesive which is said to eliminate the need for core priming in aircraft and missile sandwich-component fabrication has been introduced by Narmco Resins & Coatings Co. Trade named Narmtape XP-108, the material also improves peel strength.

Narmtape XP-108 consists of a nylon carrier impregnated with a modified phenolic resin and overcoated on one surface with a highly mobile filleting resin. Addition of the fillet reportedly eliminates the need for priming the metallic sandwich core to obtain proper adhesive filleting action. Whereas formerly the core had to be air- and oven-dried for 2-3 hours before bonding, now it can be applied directly to the metal face.

Good filleting action enables the adhesive to contact a larger area of the sandwich core column. This materially improves the peel strength and other mechanical properties of the completed face-to-core bond in a sandwich-type structure. Tensile shear, column compression, and flexural strengths also are improved, as shown by extensive laboratory testings. Narmtape XP-108 is resistant to aircraft fuels, salt spray, commercial solvents, and many other corrosive materials.



Cross section of a Narmtape XP-108 bond.

Readers' Service Item P-8

Butyrate Vending-Rack Cover

Newspapers sold from the vending racks supplied by Coin-trolled Equipment Corp., are neat and dry regardless of the weather, thanks to their transparent covers of weather-resistant butyrate. A number of firms were involved in the operation: Eastman Chemical supplied the Tenite butyrate material; Jet Specialties Co. extruded it into sheets; and Revell, Inc., vacuum formed it to the desired shape.

Butyrate cover protects newspapers from the elements.

The cover is attached to the metal rack with rivets. When the cover is down, the newspapers are locked in until the customer drops a coin into the box. This releases the cover, enabling the purchaser to pull out a paper.

Readers' Service Item P-9

Vinyl-Foam Rubber Upholstery

A completely different type of upholstery material called Naugafoam was introduced recently by the United States Rubber Co. Actually a heat sealed sandwich, the material consists of a 3/8-inch sheet of foam rubber between 25-ounce vinyl upholstery and a bottom of cotton sheeting. In the manufacturing process, Naugafoam is shaped into quilted channels 1¼ inches wide.

Vinyl-foam rubber upholstery material.

Reason for the combination, according to company spokesmen, is the combination of foam rubber's resiliency with the color, durability, and easy-to-clean features of vinyl. Suggested applications include backs, seats, front trim, and arms of davenports; ottoman covers; boat seats, bar trim; car door panels; and restaurant booths.

Naugafoam is available in 15-yard rolls 54 inches wide. Colors are crimson, yew green, ginger brown, black, and parchment.

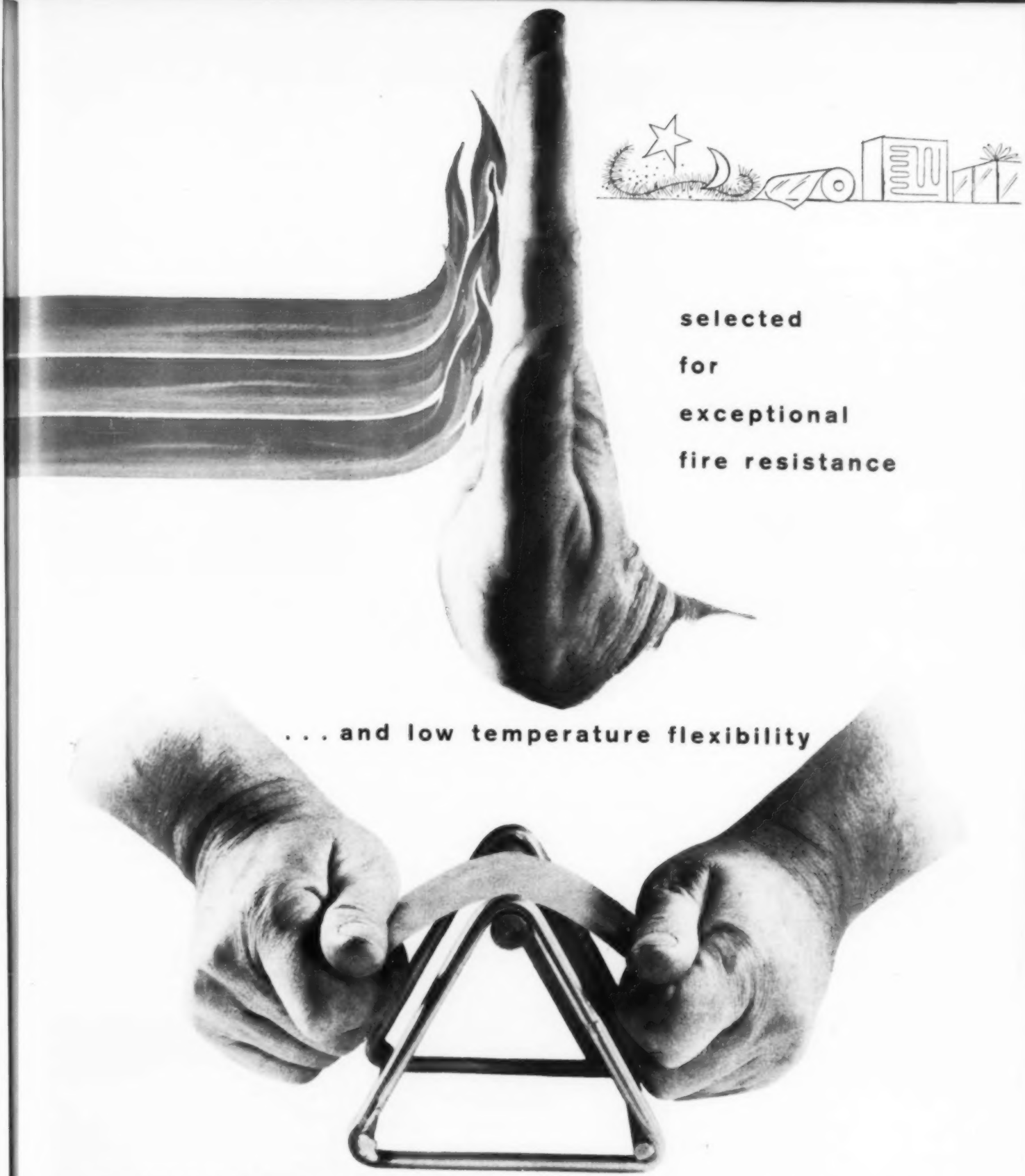
Readers' Service Item P-10

White Melamine Chessmen

A new chess set in which the white chessmen are molded from Plaskon melamine is available from Pacific Game Co. Designed by the sculptor Peter Ganine, the Gothic pieces all have faces—with distinctive, identifying visages. Lee Deane Products, Inc., did the molding; Allied Chemical & Dye's Barrett division supplied the melamine.

Unlike phenolic, which was used for the red and black pieces, melamine can be molded in light colors. The pieces are formed in a tube transfer mold utilizing

Sculptor—designer Peter Ganine with (right to left) original model, steel hob, negative mold, and finished melamine chessman.



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Celanese is an expanding source for plasticizers for many jobs. Shipments from convenient distribution points are ready to meet tight schedules. Write Celanese Corporation of America, Chemical Division, 180 Madison Avenue, New York 16, for complete information. Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16, N. Y.

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nine cavities. Two cycles produce one half-set of chessmen. A single-cycle charge requires 650 grams of melamine, which is pilled and preheated to 300° F. A Stokes 200-ton transfer press was used for the operation, and it is interesting to note that the 4½-inch high king was molded with little or no trouble.

Readers' Service Item P-11

Rotationally-cast PVC hobby horse.

Vinyl Plastic Hobby Horse

Little boys can be "tall in the saddle" with Wonder Horse, a recent introduction by Wonder Products Co. This hobby horse is perhaps the largest item ever to be molded in one piece by the rotational casting method. The plastisol formulation used was a blend of two Geon PVC resins, products of B. F. Goodrich Chemical Co.

Use of the rotational casting method overcame the size and cost limitations experienced with other plastics and other molding methods. Exceptional accuracy of detail and color is reported.

Readers' Service Item P-12

Child's Refrigerator & Stove

Ideal for a little girl's "play house" parties are the Fiberglas-reinforced polyester stove and refrigerator produced by Westred, Inc. Both units are gleaming white, resembling porcelain, and are easily cleaned with a damp cloth. Unbreakable and chip-proof, they are light enough to be moved from room to room.

The stove is fashioned to resemble a regular cooking unit, and includes various

Reinforced plastic stove and refrigerator fit perfectly into a little girl's kitchen.

regulating knobs to simulate the real thing. The refrigerator is lined with storage shelves, and is sprayed on the interior with a Zolatone finish. Dimensions of the stove are 29 inches long by 20 inches deep by 22 inches high. The refrigerator stands 30 inches high, and is 18 inches by 15 inches deep.

Readers' Service Item P-13

Coiled Vinyl Telephone Cord

The new twist- and tangle-proof telephone cords no longer owe their springy qualities to an interior metal spring, but to a new vinyl jacketing material with the memory of an elephant. Using B. F. Goodrich's Geon 81576, the cord manufacturers extrude the material on the conductors which are insulated with another Goodrich product, Geon 8818. The cord is then wound around a mandrel and subjected to heat. On cooling, the cord is set in a coiled position which is retained through countless flexings.

Geon vinyl-coated cords retain permanent spring.

Readers' Service Item P-14

Polyethylene Sprinkling Can

A lightweight, unbreakable sprinkling can with a non-leak, snap-on head has been introduced by Federal Tool Corp. Called the Rainmaster, the eight-quart polyethylene can was designed by Reinecke & Associates for maximum balance and ease of handling.

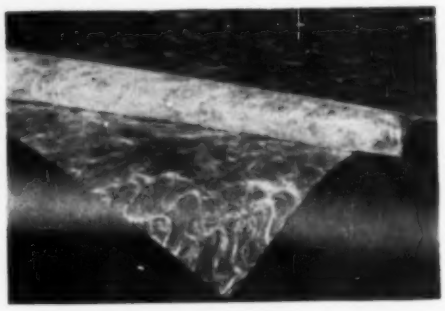
The Rainmaster can be used with the head attached for garden work, or without head for continuous fast pouring. Available in pink, daffodil, lime, and violet, the Rainmaster is 12 inches high by nine inches wide. It measures 15½ inches from spout to back.

Polyethylene Rainmaster has eight-quart capacity.

Readers' Service Item P-15

Decorative Glass Fiber Mats

The new Famco-Fiber mats presently available from Famco, Inc., offer interesting possibilities to manufacturers of reinforced-plastic luggage, lamp shades, table tops, shower enclosures, room dividers, and diffusers. Offered in a variety of patterns, colors, and thicknesses, they consist of continuous fiber strands which offer both strength and beauty. The mats also are marketed with metallic or cotton thread woven as an integral part of the design.



Famco glass fiber mats.

Readers' Service Item P-16

An Important Announcement

★ ★ ★ ★

NOW PREMIUM-QUALITY HERCOFLEX® 150 COSTS NO MORE THAN ORDINARY PLASTICIZERS

Long recognized as the quality plasticizer for quality vinyls, Hercoflex 150 (n-octyl n-decyl phthalate) is now available at the new low price of 29½ cents, tanks, delivered (31½ cents West Coast).

This price reduction is a result of a fundamental change in processing, which has opened up greatly increased supplies of the mixed straight-chain alcohols on which Hercoflex 150 is based.

At the new low price, you will find that you can use this premium plasticizer with its higher efficiency where you are now using DIDP, DIOP, DOP, or dibutyl phthalate and show definite cost savings without sacrificing product quality.

If you are not already thoroughly familiar with the properties and performance of Hercoflex 150 in plastics and coatings, write today for technical bulletin and sample. If you have already evaluated Hercoflex 150 at previous price levels, you will probably want to review your findings in the light of the changed economics. In either case, our sales and technical staffs are ready to serve you.

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New Literature

Write item numbers on Readers' Service card to obtain copies.

"Turba-Film Processor." Cat. 117. Rodney Hunt Machine Co. 22 pages. This catalog reviews the basic principles and techniques of thin-film processing, and contains flow sheets showing typical installations involving such processes as concentration, deaeration, distillation, stripping, deodorization, evaporation, desolventization, and homogenization.

Readers' Service Item L-1

"A New Resource." Amoco Chemicals Corp. 21 pages. A general product brochure which describes the company's line of petrochemicals for the paint, plastics, rubber, chemical, petroleum, and other industries. Table of typical physical properties are included.

Readers' Service Item L-2

"Simmons Industrial Fasteners." Simmons Fastener Corp. 8 pages. Dimensional drawings, specifications, and important features of the company's line of fastners are contained in this catalog.

Readers' Service Item L-3

"Phenolic Products." CDC-344. General Electric Co. 12 pages. This illustrated booklet describes the company's complete line of phenolic resins, varnishes, and molding powders.

Readers' Service Item L-4

"Molded Handwear." Bulletin 1310-2. Mine Safety Appliances Co. 8 pages. Gloves made of five types of molded rubber and synthetic materials are introduced in this illustrated bulletin. Included is a selection guide showing the relative resistance of the different materials to nearly 200 common chemicals.

Readers' Service Item L-5

"The Complete Story of Dry Coloring." Plastics Color Co. 6 pages. Dry coloring procedures, blending techniques, wetting agents, available colorants, and aids to better dispersion are discussed in this booklet.

Readers' Service Item L-6

"Got a Question About Ray-O-Lite?" Ray-O-Lite Corp. of America. 12 pages. A question and answer booklet about the company's translucent fiberglas awnings and patio roofs.

Readers' Service Item L-7

"PVC-Protected Aprons, Gloves and Garments." Jomac Inc. 6 pages. A series of three bulletins describing a new line of PVC-impregnated industrial clothing.

Readers' Service Item L-8

"Geon Vinyl Resins for Surface Coating." TB No. G.6 British Geon Ltd. 14 pages. This booklet concerns itself primarily with viscosity characteristics of various Geon 425 solutions, and describes compounding methods, solution preparation, chemical resistance and adhesion properties. Solution characteristics of Geon resins 101, 121, and 202 in six solvent systems, are tabulated.

Readers' Service Item L-9

"Hanson-Van Winkle-Munning Plastic Buffing Compounds." PBC-100. Hanson-Van Winkle-Munning Co. 2 pages. Several types of special purpose plastic finishing, and anti-static buffing compounds are listed in this bulletin.

Readers' Service Item L-10

"The Contemporary Case." Regal Plastic Co. 15 pages. Profusely illustrated, this booklet shows a wide variety of plastic carrying cases that have been designed and manufactured by the company.

Readers' Service Item L-11

"Reinforced Molding Compounds." Atlas Powder Co. 40 pages. Detailed data sheets on each of seven Atlac Thermaflow compounds are contained in this brochure. The outstanding characteristic of each member of the line is described, and a selector chart facilitates selection of the proper compound for given end-use conditions.

Readers' Service Item L-12

"Adhesives for Every Industrial Purpose." Rubber and Asbestos Corp. 5 pages. Seventeen compounds for use in applications ranging from friction coatings for gasket cloths to structural adhesives for metals and rigid plastics are discussed.

Readers' Service Item L-13

"Celanese Fortiflex A." NP-23. Celanese Corp. of America. 10 pages. Physical, electrical, and chemical properties of this ethylene polymer are tabulated; and complete processing instructions for injection molding, blow molding, extrusion, calendering, coloring, and fabrication are given.

Readers' Service Item L-14

"Its an Electrical World." Formica Corp. 7 pages. This illustrated booklet was prepared to acquaint people in the electrical and electronics industries with the use of Formica laminated plastics as an insulator. Case histories describe its uses in rotor arms, slot wedges, terminal boards, and printed circuits.

Readers' Service Item L-15

"Engineering in Plastics." V. H. Swenson Co., Inc. 4 pages. This company's services, which includes molding and secondary operations after molding, part design, and mold manufacture, are discussed in this pamphlet.

Readers' Service Item L-16

"Buflovak Flakers." Cat. 370. Blaw-Knox Co. 16 pages. This illustrated booklet describes the physical characteristics of the company's production size and pilot plant chemical flakers.

Readers' Service Item L-17

"Glass Supported Teflon." Continental-Diamond Fibre Corp. 6 pages. This brochure tabulates pertinent physical and electrical property data, and lists available grades of glass supported Teflon sheets, tapes, laminates, and metal-clads.

Readers' Service Item L-18

"Plaskon Plastics and Resins in Brief." Allied Chemical and Dye Corp.'s Barrett division. 10 pages. This booklet briefly outlines characteristics of the complete line of Plaskon plastics and resins; including melamine, urea and alkyd molding compounds, nylon molding and extrusion compounds, industrial resins, coating resins, and a mold lubricant.

Readers' Service Item L-19

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Highly Intimate Blends in 1 to 2 Minutes

Blends while discharging; No segregation or flotation

Sturtevant Rotary Blenders start 4-way blending while charging, continue it during discharge, thus producing highly intimate, even blends of dry and semi-dry materials – within 3 to 5 minutes of start of charging.

Six *complete* blending cycles per hour are common. And Sturtevant's special action produces no particle reduction, cleavage or attritional heat – is highly effective yet gentle and safe even with explosives.

Receiving

Scoops cascade material as drum rotates. Movement forces material from both ends to middle. Thus blending is 4-way right from start of charging.

Discharging

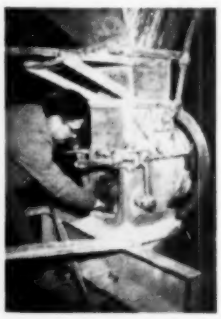
Single gate controls charge, discharge. Blending continues throughout discharge phase. Result is no segregation or flotation — highly intimate, even blends.

Self-cleaning, dust-sealed drum; one-man accessibility

Operation of Sturtevant Blenders is self-cleaning – drum interiors are completely dust-sealed. For inspection of all models, one man simply loosens a few lugs to remove manhole cover – quickly and easily.

Nine standard models with capacities to 900 cu. ft.

10 cu. ft. Sturtevant Stainless Steel Blender at U.S. Steel's Applied Research Laboratories. Corrosion and contamination-proof, this unit handles batches up to 500 lbs. — is ideal for critical work or small runs.



25 cu. ft. Sturtevant at Bird & Son, Inc., Roofing Materials Div., used to blend rock granules and pigment. Injector system supplies solution to bind color to granules. Cleanout of sticky granules is done by injecting water and raw granules at end of each shift or when color is changed, scouring drum interior.

Fully or semi-automatic, or manually controlled operation

Constructed of carbon steel, stainless steel or Monel metal, Sturtevant Rotary Blenders are engineered to fit each customer's needs – can be supplied with injector sprays and any desired control system.

For more on Sturtevant Blenders, request Bulletin No. 080B. (Bulletins also available on Mixers, Air Separators, Micronizers, Crushers and Grinders.) Write today. STURTEVANT MILL CO., 155 Clayton St., Boston, Mass.

New Literature (Cont'd.)

"1958 Guide to Improved Packaging." Union Carbide Corp. 8 pages. Properties and applications of Bakelite polyethylene film, polystyrenes, phenolics, vinyls and laminates are discussed.

Readers' Service Item L-20

"Special Purpose Machinery for the Chemical and Process Industries." PE-5802. H. W. North Co. 4 pages. An introductory bulletin illustrating and summarizing the characteristics of the firm's ball and pebble mills, blenders, dryers, autoclaves, and various type mixers.

Readers' Service Item L-21

"Decorative Lamicoid." Mica Insulator Co. 6 pages. A high pressure laminate composed of paper or fabric base materials with contrasting colored surface sheets and cores is discussed in this pamphlet. Various grades and pertinent applications are discussed.

Readers' Service Item L-22

"Taylor Laminated Plastics and Vulcanized Fibre." Taylor Fibre Co. 8 pages. Divided into two sections, this catalog describes 50 grades of laminated plastics in the first part; and outlines general uses and types of vulcanized fibre in the second.

Readers' Service Item L-23

"Epoxweld 100." Bulletin 114. Technion Design & Manufacturing Co., Inc. 2 pages. This bulletin describes Epoxweld 100 preforms, giving such information as melting point, curing temperatures and cycles, and clearances required.

Readers' Service Item L-24

"Pipewall Thickness Gage." NI-157. Industrial Nucleonics Corp. 7 pages. This bulletin describes the operation of a non-destructive gage that uses radiation to determine the extent of corrosion, erosion, or scale build-up on pipe walls.

Readers' Service Item L-25

"A Complete System of Gravure Inks for Multicolor Printing of Vinyl." TB-510. Claremont Pigment Dispersion Corp. This bulletin describes light-fastness, soap-fastness, general properties, and recommended applications for the VC-Series inks.

Readers' Service Item L-26

"Catalin Styrene Formulation and Granulations." Catalin Corp. of America. A comparative properties chart of the company's styrene molding compounds, their formulations, and granulations is contained in this leaflet. Data and properties of Catalin Formulation U, an acrylonitrile co-polymer, are included.

Readers' Service Item L-27

"Pyramid Saran." SPP-557. Pyramid Plastics, Inc. 8 pages. Shapes, sizes, physical and chemical properties, and prices of Saran rod, sheet, tape, pipe tubing, and fittings are given in this brochure.

Readers' Service Item L-28

"Versatrol." Bulletin 106. Assembly Products, Inc. 12 pages. All-purpose electrical controls suitable for use with any detectable variable together with complete ordering information is discussed in this bulletin.

Readers' Service Item L-29

"PVC Pipe Fittings, Flanges and Valves." Tube Turns Plastics, Inc. 23 pages. Complete specifications for threaded and socket-type PVC fittings made of both standard and high impact material are given. In addition, the booklet contains pressure-temperature charts, chemical resistance tables, and support spacing formulas.

Readers' Service Item L-30

"Wherever Temperature Matters." COM. West Instrument Corp. 4 pages. The company's line of temperature recorders, controllers, indicators, control systems, and accessories, are described in this bulletin.

Readers' Service Item L-31

"Picco Resins." Pennsylvania Industrial Chemical Corp. 11 pages. Property data of four basic type Picco resins are tabulated, a compatibility chart is given for specimen types, solubility characteristics are listed, and specific applications are recommended.

Readers' Service Item L-32

"Etching of Printed Circuits With Ammonium Persulfate." Bulletin 90. Food Machinery and Chemical Corp. 7 pages. This booklet outlines a new process for etching printed circuits and cites its advantages over the ferric chloride method. Preparation, processing instructions, after-treatment, and disposal of the waste solution are discussed.

Readers' Service Item L-33

Book Reviews

"Resistance of Plastics to Outdoor Exposure." R. B. Bennett, Picatinny Arsenal, U. S. Army Ordnance Corps, Feb. 1955. Order PB 131331 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 268 pages. Price, $6.00.

Prepared as a guide for Ordnance Corps engineers in the selection of plastics for use in outdoor exposure, this handbook gives weather-resistance data for 72 commercially available plastic materials, together with information on the effects of additives, fillers, and other modifiers.

The materials were grouped as thermoplastics, thermosets, cellulosics, laminates, and elastomers, and a detailed formulation for each material, the conditions of its fabrication, a statement of its special properties, and applicable Government specifications are given. The plastics are rated according to good long-term resistance, good short-term resistance, poor resistance, and resistance dependent on modifiers. Experimental results of tests on each material are included, together with information on fabrication of specimens, apportionment, and test exposure.

"Electrical Properties of Irradiated Polymers." R. E. Woodward, Wright Air Development Center. Order PB 131254 from OTS, U.S. Department of Commerce, Washington 25, D.C. Paper, 32 pages. Price, $1.00.

The effects of nuclear radiation on the electrical properties of polymers were examined in order to develop improved engineering materials for nuclear powered aircraft and supersonic vehicles. A brief discussion is given of the electronic nature of solids as it applies to insulators and then polymers. The fundamental theory of nuclear radiation is reviewed and shown to be associated with the laws of energy dissipation of radiation particles within a material. The role played by nuclear radiation in polymer kinetics is discussed, and earlier studies of the electrical properties of irradiated polymers are surveyed. An analogy is drawn between photoconductivity in semi-conductors and conductivity in certain polymers induced by nuclear radiation. The instantaneous nature of this induced conductivity is emphasized, and the change produced in the dielectric constant of an irradiated polymer is considered in terms of cross-linking and dipole movements. Also included is a survey of available engineering data for irradiated polymers.

"Glass Reinforced Plastics." Edited by Phillip Morgan. Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. Cloth, 6¼ by 10 inches, 291 pages. Price, $15.00.

This second, enlarged and revised work is edited by Phillip Morgan, editor of British Plastics. Many of the original chapters have been re-written, and new chapters on epoxide resins, the resin injection molding process, and chemical plant applications have been added. Stated purpose of the book is to provide material data, describe fabrication techniques, and discuss some problems of specialized applications.

The introductory chapter on glass fiber forms and properties is followed by chapters on the chemistry, properties, and ancillaries for polyester and allyl resins. The latter includes catalysts, reducing agents, accelerators, inhibitors, fillers, pigments, mold release agents, and light stabilizers. Other resins described in succeeding chapters include phenolics, silicones, melamines, furanes, and epoxies.

Still other chapters are devoted specifically to commercial molding processes, methods of mass production, tube and rod production, structural design, and applications for reinforced plastics in the following industries: aircraft, electricity, auto and transport, boat, and miscellaneous. Numerous diagrams and photographs are included.

"Development of Thermally Stable Polymeric Materials." C. P. Haber. U.S. Naval Ordnance Laboratory for Wright Air Development Center. Order PB 131253 from OTS, U.S. Department of Commerce, Washington 25, D.C. Paper, 67 pages. Price, $1.75.

This work was undertaken to synthesize polymeric materials with extreme chemical and thermal stability for use in various aircraft applications. The materials included elastomers, plastics, fluids, dielectrics, and adhesives. Diphenylsilane was prepared in good yields. Polymerization of this material by peroxide-initiated reactions in bulk, solution, and emulsion led only to low molecular weight, low melting solids of no apparent practical significance. The mechanism of polymerization was established as the addition of the elements of a Si-H bond of one molecule across the vinyl unsaturation of another molecule. In an attempt to prepare $(CF_3)_2$ PN polymers, a multistep synthesis was developed which gave an excellent overall yield of the desired starting material, $(CF_3)_2PCL_3$. The reaction of the starting material with ammonia and ammonium chloride under a wide variety of experimental conditions led to rearrangement, disproportionation, and ammonolysis of CF_3 groups. As a result of these side reactions, it was not possible to prepare the desired nitride powder.

"Investigation of Thermal Properties of Plastic Laminates, Cores, and Sandwich Panels, Part 2." F. R. O'Brien and S. Oglesby, Jr., Southern Research Institute for Wright Air Development Center, U. S. Army Air Force, Nov. 1955. Order PB 121191 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 79 pages. Price, $2.00.

Thermal properties were measured for a selected group of plastic laminates, cores, and sandwich panels. The properties measured included specific heats from 100-600° F., thermal conductivities, and coefficients of linear thermal expansion from —100 to 600° F. The test materials were four laminates with 181 glass fabric reinforcement, but with four different resins; three ½-inch thick, foamed-in-place, alkyd-isocyanate plastic cores; one ½-inch thick, foamed-in-place, heat-resistant plastic core; one foam sandwich panel; and one honeycomb panel. Thermal properties of the laminates were compared with those of laminates tested in the first part of the research (the report of this part of the program has not been released for publication, as yet). Foam cores, except the heat-resistant core, decomposed at relatively low temperatures. In addition, the low densities of the core materials gave less precision in the specific heat determinations.

"Development of Thermally Stable Silicon Containing Resins." L. W. Breed, F. Baiocchi, and H. W. Christie, Midwest Research Institute for Wright Air Development Center, U. S. Air Force. Order PB 131190 from OTS, U.S. Department of Commerce, Washington 25, D.C. Paper, 52 pages. Price $1.50.

Parts of this research program that have been completed are described in full. The research includes the synthesis of silane monomers which contain two silicon atoms connected by arylene groups, and which have sufficient functionality to form a thermosetting polymer when hydrolyzed and cured. Methods found suitable for synthesizing the monomers in quantities of one pound or more, were used to prepare the following compounds: 1,4-bis (methyl-diethoxysilyl) benzene, 4,4′-bis (methyldiethoxysilyl) phenylether, and phenyldichlorosilyl-trichlorosilylbenzene. A description of a statistically designed series of experiments to study the variables effective in the formation of laminates from silicone resins and glass fiber fabric also is included in the book.

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Abstracts of Important Articles

Materials

"Epoxy Plasticizers for PVC," T. C. Moorhead, *Plastics* (London), 22, 239, 343 (Aug. 1957.)

Vegetable oils and alkyl esters of their fatty acids are not sufficiently polar to be solvents for PVC. If the double bonds of the unsaturated fatty acids are converted to epoxy groups, the glycerides and certain esters of the fatty acids can be rendered compatible with PVC. The epoxidized oils and esters are shown to be of value not only as plasticizers, but also as stabilizers, and their properties are compared with those of other plasticizers and stabilizers.

"Determining Moisture in Polymers," M. R. Lardera, *Materie Plastiche*, 23, 4, 247 (April 1957.)

In determining moisture in polymers, each material must be considered individually. The author describes various methods (drying in the oven; Fischer titration; heating at 200° C. combined with very low pressure; and distillation processes), and discusses results when applied to PVC, vinyl chloride/vinyl acetate copolymer, polyacrylonitrile, and polyethylene terephthalate (Terylene). (In Italian.)

"Thermochemical Study of Reactions between Phenol and Formaldehyde," Oldrich Vlk, *Plaste u. Kautschuk*, 4, 4, 127 (April 1957.)

In this study on the thermochemistry of the formation of phenol-formaldehyde resins, values for activation energy (or heat of activation) and heat of reaction obtained as a result of tests or calculations are compared with data published by other authors. In the reaction mixtures tested, the ratio of phenol to formaldehyde ranged from 1:0.8 to 1:2 using hydrogen chloride and amonia as catalysts. (In German.)

"Water Absorption of Plastics at High Pressure," B. Dale and S. Wilson, *Rubber & Plastics Age*, 38, 6, 523 (June 1957.)

In high-pressure pistons in aircraft hydraulic equipment, plastic rings often serve to "back-up" a rubber seal and prevent its deformation under the high pressures used. Nylon has been found very suitable for this purpose. However, a study of the behavior of nylon in oil at high pressure revealed that the nylon had increased markedly in weight and dimensions, and that this was not the result of absorption of the oil, but that of the water in the oil. The work done on nylon suggests that other materials that absorb moisture also will pick up water in oil at high pressure. It is intended to extend present work to include Perspex and unplasticized PVC.

"General Classification of Expanded Plastics," W. Brenner, *Poliplasti*, 5, 20, 21 (March-April 1957.)

Expanded plastics are classified under three main heatings: flexible (polyurethane, vinyl, and polyethylene foams); rigid (polystyrene, urethane, phenolic, silicone, and syntactic foams); and pre-expanded rigid materials (polystyrene, cellulose acetate, and urea-formaldehyde). The properties which depend primarily on the properties of the starting materials are considered. (In Italian.)

"Plasticizer and Plasticization," M. S. Welling, *Rubber & Plastics Age*, 38, 7, 610 (July 1957.)

This is a survey of the most important information that has become available on the subject of plasticizers and plasticization; the classification of plasticizers; the structures of elastomers; inter-molecular forces present in plasticizer and elastomer; and theories of plasticization. The work on PVC has been referred to especially and, in this connection, the balance of polar and non-polar groups in plasticizers, and low-temperature plasticizers have been considered.

"Determining Variations in Flexibility of Plastic Sheets in Relation to Temperature," W. Voigt, *Kunststoffe*, 47, 9, 533 (Sept. 1957).

A method and apparatus are described for finding the second-order transition temperatures of plastic sheet by measuring the variations in E-modulus in relation to temperature. A problem here was how to register the least change in the length of the sample loaded with a minimal constant weight without exerting force on the sample. This was solved by the suitable use of air pressure, and some of the results are described. By this method, it is shown that the quality of extruded foil can be determined. (In German.)

"Dependence of Plasticizer Efficiency on Structure of the External Plasticizers," F. Wurstlin and H. Klein, *Kunststoffe*, 47, 9, 527 (Sept. 1957.)

External plasticization of polymers and plasticizer efficiency are considered on the basis of dielectric measurements. As in earlier investigations, it was found that when comparing different plasticizers, the internal mobility of the plasticizer molecule determines the order of efficiency, independently of the material to be plasticized, and that mobility can be characterized by the second-order transition temperature. The difference between these temperatures as found for the polymer and for the plasticizer determines the efficiency of the latter. (In German.)

"Sources of Radiochemical Applications," N. Felici, *Ind. Plastiques Mod.*, 9, 8, 39 (Sept.-Oct. 1957).

The radiation power required for chemical irradiation on experimental and industrial scales is considered, and the sources of radioactive photons and electrons, and of accelerated electrons and their applications are examined. It is concluded that so far (1956), only irradiation by high-energy electrons seems to permit industrial application at prices which, although high, industry can stand. (In French.)

"Sizing and Desizing Glass Fabrics for Laminates," J. Duflos, *Ind. Plastiques Mod.*, 9, 8, 37 (Sept.-Oct. 1957.)

For satisfactory use of glass fibers in the reinforcement of plastics, a prerequisite is the thorough removal of sizes and dressings from the surface of the glass. Various methods of testing the efficiency of desizing are discussed, including a method of determining residual size by radioactive iodine fixation, an absorption test, and an American peeling test. (In French.)

"Temperature Resistant Fiber Glass Laminates," H. Hagen, *Kunststoffe*, 47, 9, 536 (Sept. 1957.)

The present situation with regard to plastics for aviation and rocket purposes, and how they rate in resistance under various temperature/time/load conditions, are reviewed. (In German.)

"Fillers for PVC. I," Phillips and P. G. Youde, *Brit. Plastics* 30, 7, 297 (July 1957.)

The basic requirements of a filler for PVC are outlined, then fillers in common use are discussed briefly, including those that serve as stabilizers, coloring ingredients, and improve flame resistance and insulating properties; and fillers for use in the flooring industry. Methods for assessing fillers in pastes and compounds are described, and the physical properties of flexible PVC compounded with various fillers are discussed.

"Iso-polyamides, Interpolyamides," J. Hacquard, *Ind. Plastiques Mod.*, 9, 8, 43 (Sept.-Oct., 1957.)

By their properties, polyamides occupy the novel position of connecting link between the metals and the plastics, and their use seems to offer bold, new solutions to many as yet poorly solved problems posed by the growing demands of modern tech-

nology. The author reviews the preparation of polyamides from a diacid and a diamine, and from an amino acid or its lactams; interpolymers; structure of polyamide, and relation of crystalline portion to amorphous portion; and the properties processing, and applications of polyamides. (In French.)

"Investigation of the Efficiency of Halogen-containing Plasticizers for PVC," K. Thinius and W. Schwarz, *Plaste u. Kautschuk*, 4, 2, 48 (Feb. 1957).

The materials studied, products of East German firms, included chloroparaffins (compared with Chlorafin 42, of Hercules Powder Company), halogen derivatives of diphenyl, and chlorodecalin. The local chloroparaffin did not improve the PVC; chlorodiphenyl with about 60% chlorine is recommended only as an extender for other softeners; and chlorodecalin used alone gave poor heat and light stability. (In German.)

"Production, Constitution and Properties of Polyethylene and other High Molecular Polyolefines," H. Hagen, *Kunststoff-Rundschau*, 4, 3, 81; 4, 4, 136 (March & April, 1957).

Review of the various methods of preparing polyethylene; the catalysts used; irradiated polyethylene; structure and properties; outputs and applications; and isotactic polymers. There are 178 references. (In German.)

"Evaluation of Ethylenic Reactivity of Polyester Resins by means of Catalytic Hydrogenation," A. Giger, J. Henniker, J. Henniker, and L. Jacque, *Ind. Plastiques Mod.*, 9, 6, 43 (June 1957).

The authors describe a method and apparatus for determining the double-bond content of unsaturated polyesters by catalytic hydrogenation, using a palladium catalyst. Acceptable results have been obtained in the case of styrene, maleic and fumaric acids, maleic anhydride, butyl maleate, and itaconic acid. The allyl esters present certain difficulties because of side reactions, and a study of these reactions is to be published separately in the future. (In French.)

"The Coloration of Plastics by Irradiation," S. H. Pinner and A. J. Swallow, *Plastics*, (London), 22, 237, 194; 22, 238, 268 (June & July, 1957.)

It is shown that irradiation with less than 20 Mrad. produces color changes in many plastics, but has no effect on others. In some cases, these changes are transient; the original color being restorable by oxygen, action of ultra-violet light, heat, or simply by standing. In others, they are permanent; here, the effects are due to changes in the base material or the colorant, the presence of chlorinated polymer being particularly important. Various applications are suggested; transient changes, as shown by irradiated Perspex, might be useful in oxygen permeability studies. Colored tags of irradiated Perspex enclosed in transparent packages of fresh or cooked food could serve to indicate at a glance the degree of deterioration due to oxygen permeation. Greater possibilities are foreseen for permanent color changes in fast electron printing and decoration of suitably compounded PVC, and to indicate uniformity of irradiation for other purposes, (for instance, the irradiation of polyethylene and other polymers; or to indicate whether medical packs sterilized by irradiation have been adequately treated.)

"Graft Copolymers," N. G. Gaylord, *SPE J.*, 13, 12, 34 (Dec. 1957.)

In this first part of the article, grafting with vinyl monomers is discussed, with emphasis on initiation by chain transfer. Methods of grafting are covered, including initiation by activation and by activation from reactive sites. Other sub-

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. The publishers and their addresses are given below:

"Applied Plastics"
The Scientific Press, Ltd.
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London, S.W. 7, England

"ASTM Bulletin"
American Society for Testing Materials
1916 Race St., Philadelphia 3, Pa.

"Australian Plastics"
Australian Trade Publications, Ltd.
171 Sussex St., Sydney, Australia

"British Plastics"
Iliffe & Sons, Ltd.
Dorset House, Stanford St.
London S.E.I, England

"Canadian Plastics"
341 Church St., Toronto, Ont., Canada

"Chemical and Engineering News"
1155 Sixteenth St. N.W.
Washington 6, D. C.

"Hule Mexicano y Plasticos"
Filomeno Mata 13-11, Mexico, D.F.

"Industrial and Engineering Chemistry"
1155 Sixteenth St. N.W.
Washington 6, D. C.

"Industries des Plastiques Modernes"
Les Publications Techniques Associees
40 Rue du Colisee, Paris 8e, France

"Kunststoffe"
Carl Hanser Verlag
Leonard Eck Str. 7, Munich 27,
Germany

"Kunststoff-Rundschau"
Brunke Garrels, Verlagsbuchhandlung
Borgfelder Strasse 83, Hamburg 26,
Germany

"Materials and Design Engineering"
Reinhold Publishing Corp.
430 Park Ave., New York 22, N. Y.

"Materie Plastiche"
Via Farneti 8, Milan, Italy

"Matiéres Plastiques"
Galerie du Center, Bloc 3
Rue des Fripiers, Brussels, Belgium

"Mechanical Engineering"
American Society of Mechanical Engineers
29 W. 39th St., New York 18, N. Y.

"Modern Plastics"
575 Madison Ave., New York 22, N. Y.

"Oesterreichische Plastic-Rundschau"
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Aegidiengasse 5, Vienna 6, Austria

"Plaste und Kautschuk"
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12 Unter den Linden
Berlin N.W.7, Germany

"Plastic"
Danish Technical Press
31 Vester Farimogsgade
Copenhagen 5, Denmark

"Plastica"
Kunststoffeninstituut T.N.O.
Julianalaan 134, Delft, The Netherlands

"Plastics"
Temple Press, Ltd.
Bowling Green Lane, London E.C.1,
England

"Plastics World"
Cleworth Publishing Co., Inc.
1 River Road, Cos Cob, Conn.

"Plastiques Informations"
94 Rue Saint-Lazare
Paris 9e, France

"Plastverarbeiter"
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Herxheim b. Landau/Pfalz, Germany

"Poliplasti"
E.T.A.S., Via Andrea Mantegna 6,
Milan, Italy

"Revista de Plasticos"
Inst. "Alonso Barba"
Serrano 119, Madrid, Spain

"Revue Générale des Matiéres Plastiques"
196 Ave. Jean-Jaures, Paris 19e, France

"Rubber and Plastics Age"
Rubber and Technical Press, Ltd.
Tenterden, Kent, England

"SPE Journal"
Security Bank Bldg., Athens, Ohio

"Transactions of the Plastics Institute"
9 Mandeville Place, London W. 1,
England

jects covered include grafting on unsaturated polymer by addition copolymerization; grafts onto cellulose; cross-linked graft copolymer; grafting on unsaturated polymer by addition copolymerization and/or chain transfer; initiators for copolymerization; and grafting by polyaddition or condensation reactions.

"Molding, Quality Control and Some Aging Characteristics of Nylon," S. R. Prosen, *SPE J.*, 13, 12, 28 (Dec. 1957.)

The use of a cold mold and good molding procedures are shown to enhance the toughness of molded nylon items. A simple quality control test can be used to predict the performance of the end-item and distinguish between good and improper moldings.

"Glass Reinforcement for Structural Plastics," R. G. Adams and R. Sonneborn, *SPE J.*, 13, 12, 25 (Dec. 1957.)

A discussion of the manufacture of glass fibers, glass surface treatments, and the types of glass reinforcements available for use in plastics, including mats, rovings, chopped strands, milled fibers, woven fabrics, and woven rovings.

"Application of Differential Thermal Analysis to the Study of Plastics," G. Galvan, *Poliplasti*, 5, 20, 4 (March-April, 1957.)

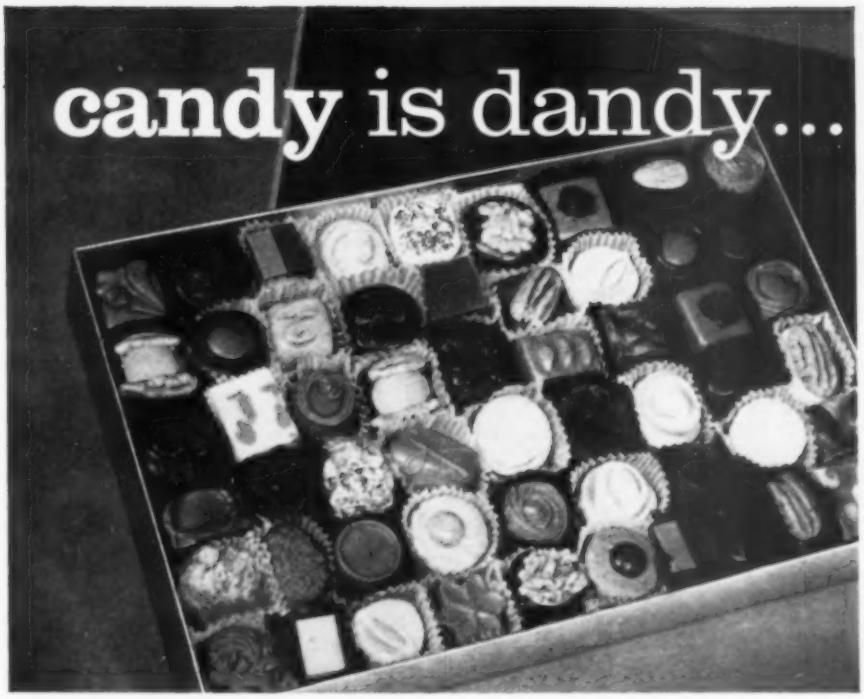
Because of the ease and speed with which it can be applied, differential thermal analysis seems destined to largely replace present analytical methods in the plastics field (e.g., spectroscopy.) The apparatus is described, how and where differential analysis is used, and the inherent limitations of the method, are discussed. (In Italian.)

"Development and Present Position of Radio-chemical Polymerization," T. Klinger, Poliplasti, 5, 20, 27 (March-April, 1957.)

Review of radiation chemistry applied in various methods of polymerizing vinyl monomers, and in the synthesis of graft polymers. (In Italian.)

"Glassfiber Reinforcements for Plastics —Problems and Developments," O. Meyer, *Kunststoffe*, 47, 8, 455 (Aug. 1957).

Recent American developments in the production of glass fibers, rovings, mats, fabrics, etc., are reviewed, and current practice in Germany is mentioned. In the discussion on sizings for glass fibers, reference is made to a Swedish combination textile-alkoxysiloxane sizing said to combine the excellent adhesion and wet strength effect of silane sizes with the very good textile processibilities of the fibers. (In German.)



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"Influence of High Energy Irradiation on the Properties of Plastics," M. M. Magat, *Kunststoffe*, 47, 8, 409 (Aug. 1957).

This is a report on the progress that has been made in the development of atomic energy plants and the use of atomic energy radiations in the polymerization, cross-linking, and graft-polymerization of plastics. This paper was presented at the 7th German Plastics Conference. (In German.)

Processing

"Joining and Fastening Plastics," M. W. Riley, *Materials Design Eng.*, 47, 1, 129 (Jan. 1958).

A survey of solvent cementing, adhesive bonding, thermal welding, and mechanical fastening, covering the plastics for which the methods can be used, the bond characteristics, design considerations, and application techniques.

"Heat Generation and Expansion Effects in the Rheology and Molding of Plastics," H. L. Toor, *SPE J.*, 14, 1, 27 (Jan. 1958).

Plastics fabrication processes are shown to be controlled by the usual laws of fluid mechanics, thermodynamics, heat conduction, and the specific rheological properties of the plastic used. Over-all energy balance, adiabatic flow, isothermal wall, and injection molding are covered.

"Molding Shrinkage and Related Effects in a Fixed-Cavity Compression Mold," Part I, W. R. McGlone and L. B. Keller, *Modern Plastics*, 35, 6, 125 (Feb. 1958).

The first part of an investigation of shrinkage components in both force and perpendicular directions as functions of molding conditions and material characteristics. Major shrinkage factors are shown to be elastic decompression of the molding and difference in thermal contraction of the material and mold.

"Vacuum Forming," O. F. Bartoo, *Plastica*, 10, 6, 374 (June 1957).

The author briefly evaluates vacuum forming as a processing method for plastics, comparing it with injection molding and mentioning the limitations of its application with regard to both type of plastic and type of product to be made. Some recently developed methods and improvements in processes and equipment are reviewed. (In Dutch.)

"Experiences in Bonding New Types of Plastics," O. Jordan, *Kunststoffe*, 47, 8, 521 (Aug. 1957.)

Because of their special properties, (such as improved heat and chemical resistance) and their surface characteristics, some of the newer types of plastics are more difficult to bond than are older products. The author shows how and to what extent satisfactory results can be obtained with polyamides, polyurethane, polyfluorocarbonates, and silicone rubbers, as well as with polycarbonates and terephthalic acid polyglycol esters (products which offer less difficulty in this respect.) He stresses, however, that simpler and improved methods are bound to be developed for these materials within the next few years. This paper was presented at the Seventh German Plastics Convention in April 1957. (In German.)

"Effect of Processing Techniques on the Properties of Injection Molded Parts," H. Volland, *Kunststoffe*, 47, 8, 513 (Aug. 1957.)

The many factors to be considered in order to produce perfect injection moldings are discussed in this paper presented before the Seventh German Plastics Convention in April 1957. In the case of technical moldings, close collaboration between customer and molder is necessary, and a questionnaire has been drawn up to facilitate this. The individual questions are discussed, and practical hints are given as to details requiring special attention. (In German.)

Applications

"Plastics in the Cinema Studio," G. Hoffmann, *Plaste u. Kautschuk*, 4, 4, 131 (April 1957.)

A description of the use of dispersions of plastics and synthetic rubber, as well as of vacuum-formed plastic sheet, in producing costumes, accessories, decorative building effects, and the like for moving pictures. (In German.)

"Plastics in Building," H. Lobner, *Plaste u. Kautschuk*, 4, 4, 138 (April 1957.)

In 1956, a huge Central Stadium was built in Leipzig which is claimed to have seating capacity for 100,000 spectators. The author discusses the construction of the built-in benches made of molded phenolic resin-impregnated wood laminate. (In German.)

"Plastics in Radio Engineering," M. Guerrini, *Materie Plastiche*, 23, 4, 280 (April 1957.)

The applications of plastics in radio engineering are reviewed, including components of polystyrene, phenolic, polyethylene, and polyamide for radio receivers, magnetophones, television, etc. (In Italian.)

"Ethoxylene Resins as Binders for Glass-reinforced Plastics," R. Stierli, *Kunststoffe*, 47, 8, 463 (Aug. 1957)

While unsaturated polyester resins exclusively have been used for glass fiber-reinforced plastics until recently, other resins also are now being employed. Ethoxylene resins especially are making headway in this field. The properties of glass fiber-resistance, and behaviour under static load. Applications in European and American countries in the automobile, airplane, electrical, plastics, and chemical industries are mentioned. This paper was presented at the Seventh German Plastics Convention in April 1957. (In German.)

"Printed Circuitry in Automobile Design," V. R. Herterick, *SPE J.*, 14, 1, 25 (Jan. 1958).

A generalized discussion of printed circuitry in auto design, with special mention of the production of printed circuits, the application potential, cost advantages, "total design" approach, the electrical devices in autos, door mechanisms, and the adhesives problem.

"Some Problems in Developing a High Tolerance Precision Laminate," M. R. Levy, *SPE J.*, 14, 1, 21 (Jan. 1958).

This paper discusses the use of a glass-polyester laminate for a pressure housing over the primary generator of a radar reflector.

"Flexible Plastics for Control of Radiation Contamination," H. A. Moulthrop, *SPE J.*, 13, 9, 21 (Sept. 1957).

This condensation of an SPE 1957 Conference paper describes how simple flexible plastic film tubes and shapes can be used to control radiation contamination.

"Reinforced Plastic Reflectors," R. L. Mondano, *SPE J.*, 13, 10, 52 (Oct. 1957).

A discussion of the problems encountered in the making of radar reflectors, and their solution.

"Urethane Products in the Home of Tomorrow," J. W. Hull, *Plastics Industry*, 15, 8, 9 (Aug. 1957).

A brief discussion of urethane foams and other products for the home.

"Vinyls in the Building Industry," Malcolm Seymour, *Plastics Industry*, 15, 8, 24 (Aug. 1957).

A generalized discussion of building applications for vinyls based on their toughness and washability.

"Nylon Parts Lengthen Life of Ball Point Pen," A. E. Simon, Jr., *Materials Design Eng.*, 47, 1, 124 (Jan. 1958).

A brief discussion of nylon parts in a ball point pen, and the advantages gained by using these plastic parts.

Patent Digest

Materials

Mixed Polyurethane Lacquer and Method of Coating Therewith. No. 2,817,643. Wilhelm Altner, Opladen, Germany. (to Farbenfabriken Bayer Aktiengesellschaft, Leverkusen, Germany.)

A lacquer comprising an organic solvent soluble linear polyurethane prepared by reacting and organic aliphatic diisocyanate with a glycol, and particles of a linear polyurethane.

Process for Raising the Melting Point of Acetone-Soluble Copolymers. No. 2,817,650. Marshall W. Duke, Midland, Mich. (to The Dow Chemical Co., Midland, Mich.).

An acetone solution of an acrylonitrile-vinylidene chloride copolymer with an acetone soluble phosphorus is prepared. The acetone is removed from the solution and the resulting composition is heated until the melting point of the copolymer has been raised.

Recovery of Amines from Coagulating Baths. No. 2,787,618. Charles S. McCandish, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

A liquor from an acqueous coagulating bath containing sulfuric acid, an inorganic salt, and an amine salt is passed through an activated carbon where a substantial amount of the components are adsorbed. The carbon is washed with hot water to recover a first washing rich in acid and inorganic salt, and a second washing rich in amine salt.

Polymerized Glycol Sulfite and Processes of Preparing the Monomer and Polymer of Glycol Sulfite. No. 2,798,877. Marcel Jean Viard, Bois-Colombes, France. (to Societe Anonyme des Manufactures des Glaces et Produits Chimiques de Saint-Gobain, Chauny & Cirey, France).

A glycol sulfite polymer is prepared by mixing 920 parts ethylene oxide and 40 parts of diethylaniline, after which 1,340 parts of sulfur-dioxide gas is passed into the mixture at 0-10° C. The mass is maintained at this temperature for 30-40 hours.

Acoustical Material. No. 2,802,764. Gaymes Slayter, Newark, O., and Robert B. Taylor, Downers Grove, Ill. (to Owens-Corning Fiberglas Corp., Toledo, O.).

An acoustical tile comprising a slab of compacted glass fibers bonded together into a rigid body; and a thin, flexible, impervious, resinous membrane extending over a major surface of it. The membrane is secured to the body along its edges, and is shrunk to a taut condition over the surface.

Polyvinyl Ester Resin Plasticized With an Epoxy Stearic Acid. No. 2,802,800. Francis J. Sprules, Caldwell, and Henry C. Marks, Glen Ridge, N. J. (to Wallace & Tiernan, Inc., Belleville, N. J.).

A polyvinyl ester resin composition plasticized with a fatty acid ester selected from the class consisting of ethylene glycol monobutyl ether epoxy stearate, tetrahydrofurfuryl epoxy stearate, and ethylene glycol monoethyl ether epoxy stearate.

Plasticization of Vinylidene Resins With Tricarballylates. No. 2,802,802. Robert J. Reid, Canal Fulton, William Mayo Smith, Jr., Cuyahoga Falls, and Byron H. Werner, Akron, O. (to Firestone Tire & Rubber Co., Akron, O.).

A crystalline resin composed of polymers of vinylidene chloride with up to 15% by weight of the resin, of another copolymerizable unsaturated compound, is plasticized with not over 10% of a trialkyl tricarballylate, each alkyl group of which contains from 1-4 carbon atoms.

Treatment of Cellulose Containing Textile Materials and Compositions Therefore. No. 2,804,402. Charles R. Williams, Chestnut Hill, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

A process of finishing textile fabrics to provide a crush resistant material which resists loss in tensile strength due to chlorination, comprises impregnating a woven textile fabric comprising at least 60% by weight of cellulose fibers with an aqueous solution of a dimethylol ethylene urea; a thermosetting, water-soluble, infinitely dilutable methyl ether of polymethylol melamine; and a curing catalyst. The fabric is heated at elevated temperatures to dry it and produce a water-insoluble finish.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.

—The Editor

Heat Stabilized Compositions Containing Alkoxyphenylglycidyl Ethers. No. 2,805,170. Allan Bell, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

A cellulose ester plastic molding composition selected from the group consisting of cellulose acetate and cellulose acetate butyrate, and a small stabilizing amount of an alkoxyphenylglycide ether.

Synthetic Resins Derived from Hydroxymethylfurfural and Para-Toluene Sulfonamid. No. 2,804,445. Francis H. Snyder, Newton, Conn. (to Dedrol, Inc., Memphis, Tenn.).

Aqueous hydroxymethylfurfural is heated with p-toluene sulfonamid in substantially equi-molecular concentrations, at a pH between 10-11 until, upon neutralization with sulfuric acid, a thermosetting resin is separated out.

Equipment

Sheet Extrusion Apparatus. No. 2,799,896. Harold J. Grow, East Orange, and Walter D. Paist, Berkley Heights, N. J. (to Celanese Corp. of America, New York, N. Y.).

The apparatus includes a sheet-extruding die; a cooled, stationary surface having a matte finish; and means for drawing the extruded sheet over the stationary surface.

Screw Press for Working Plastics. No. 2,802,238. Roberto Columbo, Turin, Italy. (to S.A.S. Lavorazione Materie Plastiche di M.I. Columbo & C., Turin, Italy).

The screw press has a central, multiple-thread screw which engages a plurality of lateral screws having a smaller number of threads. A casing encloses the screw.

Die Roll for Encapsulating Machine. No. 2,799,048. Frank E. Stirn, Monsey, and Arthur S. Taylor, Spring Valley, N. Y. (to American Cyanamid Co., New York, N. Y.).

A cavity die roll for forming soft capsules from plastic strips comprises a cylindrical die roll blank having a plurality of slots in its periphery. Each of the slots contains a capsule cavity insert having a serrated hole which receives a foraminous material. An air duct extends from the lower side of the foraminous material to a valve face on the die roll.

Rotary Hopper for Extruders and the Like. No. 2,799,047. Almar T. Widiger, Midland, and Forrest R. Lennox, Coleman, Mich. (to Dow Chemical Co., Midland, Mich.).

A positive plastics feeding means, located at the upper end of a vertically arranged extruder barrel, comprises a conical bearing seat at the upper end of the barrel; a feed cylinder, mounted for axial rotation on a matching conical bearing; and at least one helical groove extending the length of the inner barrel wall. The root diameter of the groove decreases

as it approaches the bearing seat, and a conical hopper is affixed to the upper end of the feed cylinder. An extension of the plastics-forwarding screw projects upward through the cylinder and hopper, and a means is provided for rotating the screw, the feed cylinder, and the hopper independently of each other.

Processing

Process of Making Patent Leather-Like Finish on Polyvinyl Chloride Sheet Material. No. 2,801,949. Alva Wayne Bateman, Newburgh, N. Y. (to E. I. du Pont de Nemours & Co., Wilmington, Del).

A strippable sheet of cellophane, polyethylene terephthalate, or cellulose acetate is adhered to the normally exposed surface of a sheet of preformed PVC material, by placing both sheets in contact and passing them through revolving pressure rolls, at least one of which is heated. The laminated assembly may be stored in this fashion, and the protective coating removed prior to use.

Packaging (Vacuum). No. 2,799,589. Sanford R. Grinstead, Whiting, Ind., and John B. Hanner, Stockton, Calif. (Swift & Co., Chicago, Ill.).

A product to be packaged is placed inside a thermoplastic packaging material. The inner space is vacuumized; the material is heated to render it more pliant and the edges are clamped together. A fluid pressure is exerted on the outer surface to draw the material about the product, following which the edges are sealed to form a vacuum packed package.

Process of Preparing Fibrous, Non-Woven, Porous Sheets. No. 2,802,767. Harold R. Mighton, Kenmore, N. Y. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Liquid-swellable structural fibers and a soft, elastomeric, thermoplastic binder material whose softening temperature is below that of the fibers, are intermingled and hot pressed at a median temperature to form a water vapor-impermeable composite sheet. The sheet is soaked in a liquid which swells the fibers, at a temperature between the softening temperature of the two materials. The sheet is dried, stretched, and relaxed, to form a fibrous, non-woven, porous product.

Method of Producing a Laminated Article. No. 2,802,766. Roy F. Leverenz, Inyokern, Calif.

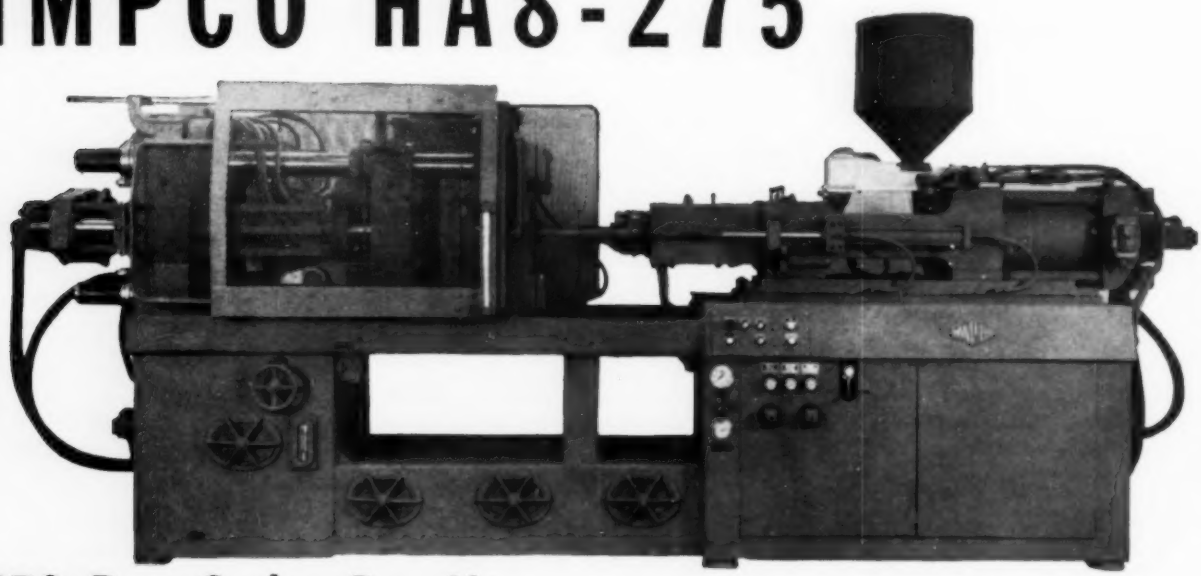
A shell of predetermined thickness containing an uncured resin is applied to the male and female sections of a mold. Over the shell is positioned a barrier laminator containing a cured resin which is compatible with that of the shell, but of different composition. The male mold section is positioned within the female section, and a core material, comprising a foaming reisn, is introduced into the annular space between them. The core material is compatible with that of the barrier laminator which separates if from the uncured resin of the shell to prevent chemical reaction. The resin is then foamed to produce a pressure which simultaneously laminates the core material to the barrier laminator, and the laminator to the shell. The combination is cured and removed from the mold as a finished article.

Extrusion of Polytetrafluoroethylene at Temperatures Above the Normal Melting Point. No. 2,791,806. John P. Tordella, Wilmington, Del. (to E. I. du Pont de Nemours and Co., Wilmington, Del.).

Unbaked polytetrafluoroethylene is subjected to an extruder temperature above its atmospheric pressure melting point at a pressure high enough to restrain its melting. The decrease in pressure upon extrusion is sufficient to cause the material to melt within the die.

Method of Producing Armoured Synthetic Plastic Tubes. No. 2,796,797. Michael Wienand, Siegburg, Germany. (to Dynamit A. G. vormals Alfred Nobel & Co.).

IMPCO HA8-275



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Applications

Nylon Roller Assembly. No. 2,805,107. Merle M. Van De Warker, Eau Claire, and Rollo Raymond Butler, Detroit, Mich. (to Crawford Door Co., Detroit, Mich.).

A roller for upward acting doors and the like comprises a nylon tire member, hub, locking ring, and a metal ring of ball bearings located between the hub and the tire. Lugs, projecting into the locking ring recess, overlie the outer margin of the locking ring to secure the ring to the recess. The tire and locking ring coact to form an outer ball bearing raceway which is sufficiently deep to surround the ball bearings and seal the chamber receiving them.

Method for Coating Wood and Products Thereof. No. 2,804,399. Harold C. Kelly and Daniel Smick, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Wooden surfaces are coated to provide them with increased resistance to breakage by applying in succession a layer of polyvinyl acetate latex, a layer of nitrocellulose, and a layer of ethyl cellulose.

Plastic Container Having an Elongatable Spout. No. 2,805,001. Joseph B. Biederman, Cincinnati, O.

A liquid dispenser comprising a hollow container having a plugged opening at its top. A one-piece flexible spout is slidably disposed inwards, and frictionally engages the walls of the opening in such a manner that it may be extended into and withdrawn from the container. A collar portion surrounding the container-opening engages a similar portion on a cap. The cap contains an elongated bore into which the spout projects, and a coaxial pin engages the interior of the outer end of the spout to close it.

Unplasticized Resin Protective Lining For Heat Exchanger Tube. No. 2,806,718. Leon A. Cook, Westfield, N. J., and Charles F. Hutcheon, Little Neck, N. Y. (to World Plastex, Bronx, N. Y.).

A protective liner for a heat exchanger tube rests in firm frictional engagement with the tube's inner wall, and is provided with an integral, flanged head member disposed adjacent to the terminal end of

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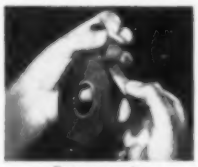

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the tube. The outer portion of the flange has a laterally-extending skirt which defines an annular groove between the outer circumference of the liner body and the inner circumference of the skirt. The groove fits over the terminal end of the tube that extends beyond the tube sheet, and is sufficiently long to abut against its surface. The liner is composed of an unplasticized, linear polyamide resin having a flow temperature of about 500° F.; a Rockwell hardness from R 115-R 120; and a modulus of elasticity of about 400,000 psi. at 77° F.

Plastic Nozzle Mounting. No. 2,805,006. John Henschert, River Forest, Ill. (to Continental Can Co., Inc. New York, N. Y.).

In a container structure, a plastic nozzle has a tubular body with an outwardly extending abutment flange at its lower extremity. The metal container wall, to which it is attached, has an upstanding neck which embraces the nozzle body in such a manner, that the abutment flange is situated firmly over the juncture of the neck with the wall, and over the wall portion surrounding the juncture. The surrounding wall portion of the flange has cooperatively engaging recesses and protuberances to prevent turning of the nozzle on the neck.

Method of Preserving and Fireproofing a Structural Member and Resultant Article. No. 2,804,398. Robert M. Hooks, Fort Worth, Tex. (to Southwestern Petroleum Co., Forth Worth, Tex.).

A structural member containing a petroleum-oil-base preservative is coated with a thermoplastic selected from the group consisting of sodium silicate, polyvinyl acetate resin, chlorinated rubber-chlorinated paraffin, and chlorinated rubber-alkyd resin. Upon exposure to heat the resinous material becomes soft, elastic, and responsive to pressure caused by heat-induced gases given off by the petroleum preservative. The action is such as to cause the thermoplastic to balloon outward away from the structural member, thus forming a gas-filled insulating chamber.

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CALENDAR of COMING EVENTS

March 27-28
Third Annual Convention, Nat'l Assn. of Store Fixture Manufacturers, Conrad Hilton Hotel, Chicago, Ill.

April 14-15
Ninth Conference on Rubber and Plastics, American Inst. of Electrical Engineers, Sheraton Mayflower Hotel, Akron, O.

April 14-17
Design Engineering Show, International Amphitheatre, Chicago, Ill.

April 21-23
Seventh Annual Meeting, Building Research Institute, Shoreham Hotel, Washington, D. C.

April 22-23
Annual Meeting, Fiberglass Reinforced Panel Council, SPI, Phillips Hotel, Kansas City, Mo.

April 28-29
16th Annual SPI Canadian Section Conference, Royal Connaught Hotel, Hamilton, Ont., Can.

May 1-8
26th Annual Convention and Tool Show, American Society of Tool Engineers, Convention Center, Philadelphia, Pa.

June 9-12
1958 Microscopy Symposium, Del Prado Hotel, Chicago, Ill.

June 30—July 4
1958 Gordon Research Conferences on Elastomers & Polymers, University of Rhode Island, Colby Junior College, New London, N. H.

June 9-21
Triennial meeting, International Organization for Standardization, Harrogate, England.

June 12-14
86th Annual Meeting, Manufacturing Chemists' Association, The Greenbrier, White Sulphur Springs, W. Va.

June 15-19
Semi-annual meeting, ASME, Hotel Statler, Detroit, Mich.

June 22-27
Annual meeting, ASTM, Hotel Statler, Boston, Mass.

June 30-July 4
1958 Gordon Research Conferences on Elastomers and Polymers, University of Rhode Island, Colby Junior College, New London, N. H.

Domestic Production and Sales of Plastics and Resin Material, October and November, 1957

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of October and November, 1957. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

Although both production and sales figures for October showed slight to considerable increases over those for this period in 1956, an examination of November sales shows some reduction, which probably results from year-end consolidation of inventories. Cellulosics, styrenes and polyesters remained about the same with fluctuations being less than 1%. Sales of phenolics, ureas, coumarone-indenes fell off; while polyethylene sales rose about 25%.

	October, 1957		November, 1957	
	Production	Sales	Production	Sales
Cellulose Plastics[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,346,583	1,568,396	1,309,972	1,211,424
Sheets, 0.003 gage and over	1,638,769	1,739,921	1,731,500	1,702,362
All other sheets, rods, and tubes	827,641	713,925	611,426	697,781
Molding and extrusion materials	9,662,913	9,656,546	7,623,546	7,935,671
Nitrocellulose sheets, rods, and tubes	329,656	345,046	338,591	323,931
Other cellulose plastics	546,232	551,876	343,936	310,451
TOTAL	14,351,794	14,575,710	11,958,971	12,181,620
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	20,666,580	25,133,080	15,808,001	8,922,556
Bonding and adhesive resins for—				
Laminating (except plywood)	5,475,943	4,887,995	4,437,860	3,445,011
Coated and bonded abrasives	1,488,261	1,850,995	1,257,448	1,171,254
Friction materials (brake linings, clutch facings, and similar materials)[7]				
Thermal insulation (fiber glass, rock wool)	4,707,490	5,257,211	3,849,761	3,719,902
Plywood	3,833,618	3,531,034	3,662,573	3,153,883
All other bonding and adhesive uses				
Protective-coating resins, unmodified and modified except by rosin	2,956,656	2,357,528	2,389,221	1,786,612
Resins for all other uses	3,320,708	2,873,475	2,940,988	2,430,254
TOTAL	48,273,885	51,932,205	40,158,114	29,836,925
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	3,143,138	3,248,093	3,147,178	2,842,903
Paper-treating and paper-coating resins	1,704,449	1,866,428	1,991,262	1,742,206
Bonding and adhesive resins for—				
Plywood	9,379,114	8,439,444	7,855,371	7,208,250
All other bonding and adhesive uses, including laminating	3,489,622	3,359,958	3,277,642	2,619,470
Protective-coating resins, straight and modified	3,555,595	2,567,595	2,841,313	2,017,452
Resins for all other uses, including molding	8,217,171	8,754,570	6,654,945	7,380,440
TOTAL	29,489,089	28,236,088	25,767,711	23,810,721
Styrene Resins:				
Molding materials[1]	39,001,417	38,024,003	34,750,816	31,387,831
Protective-coating resins, straight and modified	8,646,506	7,099,652	7,471,546	5,918,109
Resins for all other uses	13,757,877	12,735,183	12,987,046	10,944,975
TOTAL	61,405,800	57,858,838	55,209,408	48,250,915
Vinyl and Vinyl Chloride Resins:[2]				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		10,746,639		7,077,922
Sheeting (resin content)		5,101,700		5,141,662
Molding and extrusion (resin content)		20,819,300		16,939,555
Textile and paper treating and coating (resin content)[3]		6,802,134		6,151,239
Flooring (resin content)		7,506,081		6,224,437
Protective coating (resin content)		2,256,342		1,915,845
All other uses (resin content)		4,466,092		4,702,844
All other vinyl resins for—				
Adhesives (resin content)		3,770,681		3,197,232
All other uses (resin content)		10,886,704		9,264,876
TOTAL	77,087,798	72,355,673	71,535,307	60,615,612
Coumarone-Indene and Petroleum Polymer Resins	23,087,566	22,785,648	19,718,121	9,558,436
Polyester Resins	7,975,507	7,094,706	6,588,956	5,809,090
Polyethylene Resins	62,551,826	66,805,870	62,935,598	58,395,275
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[1, 4]	5,075,028	4,822,323	4,742,495	4,430,953
Protective-coating resins[5]	1,155,750	609,023	1,183,316	479,489
Resins for all other uses[6]	12,605,734	10,662,510	11,303,526	8,508,807
TOTAL	18,836,512	16,093,856	17,229,337	13,419,249
GRAND TOTALS	343,059,777	337,738,594	311,101,523	261,877,843

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, nylon, silicone, and other molding materials.
[5]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
[7]Included with "All other bonding and adhesive uses."
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Current Market Prices

This listing is as comprehensive and up-to-date as possible. The full listing will appear three times a year, while intervening issues will carry a briefer tabulation of price changes and additions.

Companies whose products do not appear are invited to submit price data for inclusion in the listing. All suppliers are requested to submit product additions and price changes promptly as they occur, in order to make this listing of maximum value to our readers.

Prices, in general, are f.o.b. works. Ranges indicate quantity or grade variations. No guarantee of these prices is made, and spot prices should be obtained from the individual suppliers.

— The Editor

Adhesives

Ampcoflex Adhesive	gl.	$2.75 /	$3.50
Bakelite BC—17613	lb.	.54	.84
BCU-40	lb.	.18	.48
BR-11938	lb.	.285	.585
Bonding resins, abrasives	lb.	.20 /	.915
Brake linings	lb.	.215	.6275
Foundry resins	lb.	.2075	.395
Heat Insul. resins	lb.	.1425/	.37
CD Cement Nos. 200, 201, 202, 203, 204	gl.	.94 /	1.50
PS-7	gl.	2.12 /	2.90
Dow Corning C-271	lb.	1.64 /	1.89
Eccobild 314	lb.	.95 /	1.20
318	lb.	1.30 /	1.75
Epon Adhesive VI, VIII	lb.	3.08 /	3.30
IX	lb.	4.25 /	4.50
Epoxy Adhesive A-1, A-3, A-4	gl.	4.45 /	6.90
A-2, A-5	gl.	5.60 /	8.00
A-6	gl.	5.80 /	8.00
C-1, C-2, C-3, C-9	gl.	5.60 /	8.00
C-4, C-7	gl.	3.69 /	5.30
Flexible Resin No. 1	gl.	4.45 /	6.90
G-E 12316	lb.	.30 /	.39
12353	lb.	.225 /	.385
Melmac 401	lb.	.45	
421	lb.	.45 /	.47
Melurac 300, 302	lb.	.23 /	.29
301	lb.	.28 /	.33
Metlbond 2002-14	gl.	1.84 /	5.00
4021 Type I	sq. ft.	1.43	
Type II	gl.	1.29 /	3.20
Type III	gl.	1.49 /	3.50
Plaskon Phenolic Bonding Resin	lb.	.16 /	.21
Urea Adhesive 530-11L	lb.	.1875/	.2175
Liquid Adhesive, 2L Types	lb.	.105 /	.115
WR Types	lb.	.0675/	.125
Spray Dried Adhesives	lb.	.18 /	.29
Plastic Cement	gal.	2.25 /	2.70
Pliobond 20	gal.	4.50 /	7.00
30	gal.	5.25 /	8.00
Polyester Foam Cement PC-232	gal.	2.40 /	2.90
Schenectady SP-7401	lb.	.29 /	.31
Schwartz Vinyl Cement	gl.	1.24 /	1.50
Synvarite US #1	lb.	.195 /	.215
Synvarol T	lb.	.125 /	.16
T-3	lb.	.0875/	.1225
T-15, T-15D	lb.	.1275/	.1625
TN, TUN	lb.	.1325/	.1675
TN-231	lb.	.14 /	.175
WR-513	lb.	.0875/	.1225
WR-515	lb.	.0825/	.1175
WR-520	lb.	.0625/	.0925
Styrofoam Adhesive #5	gal.	3.75 /	4.75
Thixon CB	gal.	3.30 /	3.70
CB-2	gal.	3.75 /	3.95
IB	gal.	3.75 /	4.15
NB	gal.	4.05 /	4.45
NM-2	gal.	7.20 /	8.00
Urac 110	lb.	.205 /	.225
115	lb.	.24 /	.26
180	lb.	.095 /	.12
185	lb.	.1625/	.2175
186	lb.	.0875/	.1125
192	lb.	.07	

Anti-Static Agents

Anstac-2M	gl.	1.75 /	2.00
Hanson-Van Winkle-Munning PC-19	lb.	.322 /	.402
PC-52	lb.	.166 /	.246
PC-93	lb.	.288 /	.368
Logostat	gal.	1.35 /	1.65
Merix Anti-Static #79	gl.	.75 /	3.85
#79-OL	gl.	.75 /	3.85

Catalysts

Advance cobalt naphthenate 6%	lb.	$0.4825/	$0.5825
Cobalt tallate 6%	lb.	.4375/	.5375
Advasol	lb.	.4375/	.5375
Aritemp Curing Agent 105	lb.	2.00 /	2.25
Bakelite BH-17618	lb.	.33 /	.63
BHU-53	lb.	.15 /	.45
ERL series	lb.	.67 /	1.195
Cadet benzoyl peroxide, granules	lb.	.98 /	2.00
Paste	lb.	.95 /	2.25
Powder	lb.	1.50 /	2.37
Dichlorobenzoyl peroxide	lb.	3.00 /	4.25
Lauroyl peroxide	lb.	1.90 /	3.50
Methyl ethyl ketone peroxide	lb.	1.85 /	4.00
Catalyst 57	lb.	.12	
196	lb.	.10	
C-110, -180, -180-S, C-110-S, WF-100, -101	lb.	.12	
Celanese accelerators D & E	lb.	.43 /	.50
Benzol peroxide paste	lb.	2.00	
Catalyst MC-1	lb.	2.25 /	2.50
Emerson & Cuming Catalyst 209	lb.	.95 /	4.00
211	lb.	2.25 /	4.50
217	lb.	3.40 /	4.50
Epon Curing Agent BF3-400	lb.	4.00 /	4.50
C-111	lb.	.6225	1.10
D	lb.	3.33 /	4.75
T	lb.	.80 /	1.11
U	lb.	.86 /	1.02
Z	lb.	1.265 /	1.56
Furane H-736-A	lb.	1.30 /	2.00
Marblette Hardener 11	lb.	1.17 /	1.65
16, 661, 680	lb.	1.25 /	1.70
20	lb.	1.17 /	1.40
21	lb.	1.27 /	1.40
41, 665	lb.	1.32 /	1.77
175, 179	lb.	.50 /	.65
645H	lb.	1.15 /	1.70
681, 901	lb.	1.20 /	1.80
900, 903	lb.	2.10 /	2.50
H C Promoter 6%	lb.	.5275/	.6275
12%	lb.	.9025/	1.0025
Het anhydride	lb.	.55	
HN 551	lb.	.93 /	1.40
901	lb.	.36 /	.80
951 Ciba	lb.	.82 /	1.32
951 Furane	lb.	1.30 /	2.00
IC activators		3.00	
Inhibitor	lb.	.98	
Melurac 255, 259	lb.	.35	
Modifier CB-110, WF-61	lb.	.15	
P-27	gal.	10.00	
Plaskon Hardeners, Liquid	lb.	.07	
Powdered	lb.	.10 /	.46
Spray dried	lb.	.10 /	.25
Promoter D-2	lb.	1.60 /	2.00
Quick-Set Accelerator 804	gal.	9.80	
Reichhold Hardeners 2600, 2601, 2602, 2603, 2604	lb.	.80 /	1.58
Resolin epoxy hardeners	lb.	1.14 /	2.50
HN-951	lb.	0.86 /	1.74
SA Hardener	lb.	.10	
Sealset 701	gal.	20.00 /	22.00
702	gal.	9.20 /	10.00
703	gal.	18.00 /	19.20
Soligen	lb.	.4825/	.5825

Coating Resins

Acme 150, 160	lb.	2.00 /	2.50
Dispersant A	lb.	.75 /	1.00
Acryloids	lb.	.30 /	.87
Amberlacs	lb.	.2625/	.2875
Amberols, phenolic types	lb.	.2125/	.375
Rosin maleic types	lb.	.21 /	.345
Bakelite Phenolics	lb.	$0.28 /	$0.64
Styrene emulsions	lb.	.1375/	.31
Vinyl acetates	lb.	.295 /	.66
Solutions	gal.	5.10	
Alcohols	gal.	2.27 /	2.76
Butyral resins	lb.	1.04 /	1.24
Chlorides	lb.	.41 /	.61
Chloride-acetates	lb.	.38 /	.66
Modified	lb.	.44 /	.72
Celanese PVA emulsions, homopolymers	lb.	.17 /	.26
Copolymers	lb.	.19 /	.28
Chemigum latices	lb.	.46 /	.60
Cymel 243-3	lb.	.38 /	.385
245-8	lb.	.34 /	.345
247-10	lb.	.385 /	.39
248-8	lb.	.365 /	.37
Dow Corning 805, 808	lb.	1.54 /	1.65
806	lb.	1.85 /	1.98
840	lb.	1.52 /	1.73
Dylex K-500, -600, -700, -900	lb.	.30 /	.46
G-E 13110	lb.	.30 /	.39
Kel-F Dispersion (dry wt.)	lb.	12.00	
Ladcote FHHF-4010, FYHF-4010	lb.	.3575/	.4075
Plaskon Alkyds	lb.	.1075/	.3375
Modified	lb.	.15 /	.2625
Ester Gums	lb.	.1425/	.2475
Maleics	lb.	.1825/	.275
Melamines	lb.	.195 /	.435
Phenolics	lb.	.3925/	.475
Modified	lb.	.1825/	.29
Phenolic Laminating Varnishes	lb.	.165 /	.27
Silicone Alkyds	lb.	1.10 /	2.40
Ureas	lb.	.195 /	.435
Pliolite latices	lb.	.30 /	.39
Pliolite N R	lb.	.93 /	1.22
S-3	lb.	.42 /	.44
S-5	lb.	.49 /	.51
Milled	lb.	.54 /	.56
S-7	lb.	.88 /	1.01
Polyfluoron liquid dispersions	lb.	2.65 /	3.85
Paste dispersions	lb.	4.20 /	4.40
Primer 140	gl.	7.88 /	8.25
Reichhold Coating Resins: Beckacite, floor covering	lb.	.2175/	.2575
Modified phenolic	lb.	.1975/	.2475
Non-phenolic	lb.	.215 /	.3175
Super, pure phenolic	lb.	.2925/	.5825
Beckamine U-F	lb.	.1975/	.35
Super, melamine	lb.	.3275/	.3975
Beckolin	lb.	.2225/	.355
Beckopol	lb.	.2525/	.2625
Beckosol Solutions, epoxy esters	lb.	.37 /	.40
Modified	lb.	.18 /	.23
Non-phthalic	lb.	.16 /	.2325
Phenolated	lb.	.16 /	.2425
Pure-drying	lb.	.1525/	.28
Non-drying	lb.	.205 /	.295
Super, isophthalic	lb.	.2075/	.3025
Epoxy resin	lb.	.595 /	.6975
Hard resin solutions	lb.	.115 /	.195
Hydrogum	lb.	.17 /	.245
Kopol	lb.	.2675/	.2725
Pentacite, non-phenolic	lb.	.17 /	.2425
Piyophen phenolics, alcohol-soluble	lb.	.17 /	.725
Liquid resins	lb.	.165 /	.20
Powdered	lb.	.30 /	.325
Solution	lb.	.2575/	.2875
Water-soluble	lb.	.111 /	.30
Resin emulsions, alkyd	lb.	.23 /	.27
Wallpol	lb.	.17 /	.23
Styresol	lb.	.2075/	.2475
Synthe-Copal	lb.	.1625/	.20
Wallkyd	lb.	.12 /	.195
Schenectady Alkyds SA Type	lb.	.3575/	.38
SE Type	lb.	.3675/	1.435
SEA Type	lb.	.3575/	.38
Styrenated	lb.	.22 /	.2625
Maleics	lb.	.1725/	.23
Phenolics	lb.	.2325/	.53
Modified	lb.	.1825/	.275
Schwartz AT-25	gl.	.63 /	1.00
BK-40	gal.	3.80 /	3.95
Versamid 100	lb.	.51 /	.69
115	lb.	.64 /	.82

Colors

Acheson 0100 Series Paste Dispersions: Blacks	lb.	.50 /	.81
Blues	lb.	.55 /	2.175
Green	lb.	2.51 /	2.69
Orange	lb.	.67 /	.85
Reds	lb.	1.08 /	1.34
White	lb.	.52 /	.70
Yellows	lb.	.57 /	.75
Advabrite M-10	lb.	2.25 /	2.40
Advance Brightener M.D.A.C.	lb.	12.00 /	15.00
Akron Chemical Colors: Dry blends, reds	lb.	1.08 /	1.23
Yellows	lb.	.58 /	.88
Organic colors, blues	lb.	.75 /	3.60
Greens	lb.	1.35 /	3.95
Reds	lb.	1.10 /	4.40
Yellows	lb.	2.00 /	5.00

Pastes, blues	lb.	$1.25 /	$1.58
Greens	lb.	1.85 /	1.90
Reds	lb.	1.10 /	1.40
White	lb.	.55 /	.60
Yellows	lb.	1.70 /	1.75
Cabot carbon blacks:			
Black pearls 2	lb.	.70 /	.78
71	lb.	.32 /	.40
74	lb.	.24 /	.32
81	lb.	.084 /	.135
0	lb.	.12 /	.19
Carbolac 2	lb.	.70 /	.79
Elf 0	lb.	.12 /	.19
Elftex 3, 5, 8	lb.	.085 /	.135
Monarch 71	lb.	.32 /	.40
74	lb.	.24 /	.32
81	lb.	.095 /	.16
Sterling R	lb.	.0525/	.0925
S	lb.	.045 /	.0875
Supercarbovar	lb.	.47 /	.54
Cadmolith Reds	lb.	1.72 /	2.20
Yellows	lb.	1.12 /	1.20
California Ink, P. C. color dispersions:			
Black	lb.	.76 /	.77
Blues	lb.	.90 /	2.17
Brown	lb.	.56 /	.57
Green	lb.	2.05 /	2.06
Reds	lb.	.61 /	2.67
White	lb.	.72 /	.73
Yellows	lb.	.62 /	.74
P. C. plasticized boat colors:			
Black	lb.	.76 /	.77
Blue	lb.	1.32 /	1.33
Blue-green	lb.	1.21 /	1.22
Green	lb.	2.12 /	2.13
Red	lb.	2.69 /	2.70
Yellow	lb.	1.71 /	1.71
Carbic Colors:			
Permanent Carmine FBB	lb.	6.16	
Red FGR	lb.	3.07	
Yellow GR	lb.	3.50	
PV-Carmine B	lb.	5.40	
PV-Carmine HR	lb.	6.50	
PV-Fast Orange GRL	lb.	27.27	
PV-Fast Red B	lb.	28.00	
PV-Fast Violet BL	lb.	16.50	
PV-Fast Yellow HR	lb.	5.10	
PV-Orange G	lb.	3.30	
PV-Red G	lb.	4.27	
PV-Violet G	lb.	13.60	
PV-Yellow G	lb.	4.46	
PV-Yellow GG	lb.	4.00	
Claremont 4000-Series Pastes:			
Blacks	lb.	.82 /	1.01
Blue	lb.	.80	
Browns	lb.	.65 /	2.30
Greens	lb.	.80 /	2.15
Orange	lb.	1.58	
Reds	lb.	5.60 /	6.95
Silver	lb.	1.02	
White	lb.	.715	
Yellows	lb.	.65 /	2.87
D-Series pastes,			
Blacks	lb.	.48 /	.64
Blues	lb.	.62 /	1.57
Browns	lb.	.48 /	1.67
Golds	lb.	2.31 /	2.49
Green	lb.	1.78 /	1.88
Oranges	lb.	.71 /	4.27
Reds	lb.	1.10 /	6.36
Silver	lb.	.89 /	.91
Whites	lb.	.47 /	.60
Yellows	lb.	.56 /	3.70
K-Series pastes,			
Blacks	lb.	.56 /	.71
Blues	lb.	.89 /	1.40
Browns	lb.	.53 /	.55
Greens	lb.	.92 /	1.41
Metallics	lb.	.89 /	2.47
Orange	lb.	.86 /	4.45
Reds	lb.	.99 /	6.85
Violets	lb.	2.28 /	2.30
Whites	lb.	.59 /	.60
Yellows	lb.	.72 /	3.02
Maxiprint Series Inks:			
Black	lb.	.50 /	.53
Blues	lb.	.68 /	1.50
Greens	lb.	.68 /	1.10
Metallics	lb.	.67 /	1.20
Orange	lb.	.71 /	.74
Red	lb.	.84 /	1.13
Violet	lb.	1.18 /	1.21
White	lb.	.51 /	.54
Yellows	lb.	.65 /	.68
MB-Series Inks:			
Black	lb.	.85	
Blue	lb.	1.25	
Clears	lb.	.65 /	.66
Green	lb.	1.30	
Metallics	lb.	1.20 /	1.25
Orange	lb.	1.05	
Pearl	lb.	1.17	
Red	lb.	1.11	
White	lb.	.68	
Yellows	lb.	.90 /	1.23
MY Series Inks:			
Black	lb.	.70	
Blue	lb.	1.25	
Clears	lb.	.57 /	.62
Green	lb.	1.35	
Greengold	lb.	1.90	
Orange	lb.	.85	
Pearlescent	lb.	1.95	
Reds	lb.	1.15 /	2.95
White	lb.	.55	
Yellows	lb.	.75 /	1.35
Mylar printing Inks:			
Aluminum	lb.	$0.99	
Black	lb.	.81	
Blue	lb.	1.18	
Bronze reducing clear	lb.	.51	
Gold concentrate	lb.	1.07	
Green	lb.	1.27	
Hi-viscosity clear	lb.	.69	
Orange	lb.	.97	
Pearlescent concentrate	lb.	1.98	
Red	lb.	1.19	
Reducing clear	lb.	.68	
White	lb.	.53	
Yellows	lb.	.83 /	$1.21
PE-Series, granular concentrates:			
Blacks	lb.	.86 /	1.05
Blues	lb.	2.98	
Green	lb.	3.00	
Metallics	lb.	1.27 /	1.66
Oranges	lb.	1.12 /	2.75
Reds	lb.	1.93 /	5.25
Whites	lb.	.70 /	.85
Yellows	lb.	.78 /	3.10
PX-Series pastes:			
Blacks	lb.	1.58 /	2.15
Blues	lb.	1.15 /	2.60
Browns	lb.	1.08 /	1.47
Green	lb.	2.76 /	2.86
Grey	lb.	1.30 /	1.40
Metallic, silver	lb.	1.45 /	1.55
Orange	lb.	1.48 /	1.58
Reds	lb.	2.25 /	3.95
White	lb.	.92 /	1.02
Yellows	lb.	2.05 /	2.55
RP-Series inks:			
Aluminum	lb.	.89	
Black	lb.	.58	
Blue	lb.	1.08	
Gold	lb.	.95	
Green	lb.	1.12	
Orange	lb.	.83	
Pearlescent	lb.	1.87	
Red	lb.	1.06	
Reducing clears	lb.	.47 /	.65
White	lb.	.49 /	
Yellows	lb.	.71 /	1.09
UR-Series pastes:			
Black	lb.	1.00	
Blue	lb.	1.82	
Brown	lb.	2.00	
Green	lb.	2.20	
Orange	lb.	1.68	
Reds	lb.	1.92 /	3.55
White	lb.	.83	
Yellows	lb.	1.75 /	2.15
VC-Series Inks:			
Black	lb.	.56	
Blue	lb.	.68 /	1.15
Clear	lb.	.39 /	.55
Green	lb.	1.155	
Metallics	lb.	.72 /	1.54
Orange	lb.	.68	
Pearl	lb.	1.96	
Red	lb.	1.17	
White	lb.	.37	
Yellows	lb.	.61	
VC-Series Inks, arc resistant:			
Black	lb.	.68	
Blues	lb.	.79 /	1.05
Clears	lb.	.51 /	.53
Greens	lb.	.80 /	1.17
Metallics	lb.	.74 /	1.37
Orange	lb.	.81	
Reds	lb.	1.08	
Violet	lb.	.96	
White	lb.	.54	
Yellows	lb.	.69 /	1.15
Columbian Carbon colors:			
Aqueous dispersions			
Aquablak No. 1	lb.	.20 /	.21
3	lb.	.125 /	.135
15	lb.	.115 /	.125
26	lb.	.1025/	.1125
41	lb.	.34 /	.35
B	lb.	.0975/	.1075
G	lb.	.12 /	.13
H	lb.	.23 /	.24
K	lb.	.12 /	.13
L	lb.	.14 /	.15
M	lb.	.11 /	.12
S	lb.	.12 /	.13
U	lb.	.23 /	.24
X	lb.	.11 /	.12
Coloidex No. 3	lb.	.14 /	.21
No. 8	lb.	.16 /	.23
Hiblak AE	lb.	.10 /	.11
Colloidal dispersions			
Coacetateblak CQ-21	lb.	.875 /	.90
Coblac 405	lb.	.90 /	.925
DD Sol.	lb.	.70 /	.725
Industrial	lb.	.73 /	.755
Coethloblak CK	lb.	1.03 /	1.055
Coresinblak No. 3	lb.	.76 /	.785
Costyreneblak 903	lb.	.595 /	.62
CJ-21	lb.	.5425/	.5675
Covarnishblak AR	lb.	.6475/	.6725
BK	lb.	.565 /	.59
BJ	lb.	.52 /	.545
Covinylblak BA	lb.	.95 /	.975
BD	lb.	.97 /	.995
BF	lb.	.70 /	.725
BH	lb.	.66 /	.685
BL	lb.	.82 /	.845
BM	lb.	.77 /	.795
CA-18	lb.	$1.0725/	$1.0975
Cowaxblak BV-25	lb.	.515 /	.54
CB-18	lb.	.6225/	.6475
CM-83	lb.	.485 /	.51
DC Globak	lb.	.80 /	.825
DCV Coblac	lb.	.83 /	.855
Mapico colors, black	lb.	.1475/	.15
Browns	lb.	.1575/	.16
Crimsons, reds	lb.	.1425/	.145
Tans	lb.	.2325/	.235
Yellows	lb.	.12 /	.1275
Electronic Grades:			
110-2, EG-80	lb.	.1425/	.145
EG-1, EG-2	lb.	.2325/	.235
EG-3	lb.	.1575/	.16
Paint Grades			
140	lb.	.1025/	.18
999	lb.	.26 /	.34
Excelsior	lb.	.135 /	.21
Molacco	lb.	.0625/	.125
Beads	lb.	.0575/	.115
Neo Spectra MK. 1	lb.	.98 /	1.07
MK. 11	lb.	.78 /	.87
MK. 111	lb.	.47 /	.55
Ravens 11 & 15	lb.	.1025/	.18
Beads	lb.	.0775/	.17
Royal Spectra	lb.	1.66 /	1.78
Statex	lb.	.0725/	.13
Beads	lb.	.0625/	.12
Super Spectra	lb.	.70 /	.79
Superba	lb.	.36 /	.44
Continex HAF	lb.	.0725/	.13
SRF	lb.	.0525/	.11
Cyanamid inorganic pigments:			
Cobalt blues	lb.	.28 /	.35
Chrome greens	lb.	.42 /	.46
Oranges	lb.	.35	
Yellows	lb.	.35	
Iron blues	lb.	.52 /	.54
Molybdate chrome oranges	lb.	.48	
Ultramarine blues	lb.	.19 /	.325
Zinc yellow	lb.	.29	
Powders, Unitane-O	lb.	.255 /	.265
Unitane-OR	lb.	.275 /	.285
Organic dyes, Indulines	lb.	.89 /	1.07
Nigrosines	lb.	.65 /	.94
Oil-soluble black	lb.	.68	
Blue	lb.	8.02	
Orange	lb.	1.06	
Reds	lb.	1.49 /	2.28
Yellows	lb.	1.21 /	4.16
Spirit-soluble black	lb.	2.95	
Brown	lb.	5.30	
Orange	lb.	5.87	
Red	lb.	6.41	
Yellows	lb.	4.62 /	4.94
Pigments, alkali blues	lb.	1.45 /	2.48
Benzidine oranges	lb.	3.30	
Yellows	lb.	.69 /	3.40
Bon reds	lb.	1.30 /	2.00
Carteret red	lb.	.98	
Chlorinated para reds	lb.	1.30	
Clarion orange	lb.	1.65	
Red	lb.	1.35	
Dinitraniline oranges	lb.	1.30	
Fugitive peacock-blue lakes	lb.	1.27	
Hansa yellows	lb.	2.20	
Lithol reds	lb.	.93 /	1.03
Methyl violet toner	lb.	1.35	
Naphthol reds	lb.	.80 /	.85
Orange lakes	lb.	.85 /	.90
PTMA blue	lb.	3.55	
Greens, Lincoln	lb.	3.30 /	6.60
Violet	lb.	4.35	
Para reds	lb.	1.15 /	1.21
Phloxine toner	lb.	1.85	
Phthalocyanine blues	lb.	.90 /	4.20
Greens	lb.	3.95	
Pigment green	lb.	1.35	
Scarlet	lb.	1.65	
Red Lake C's	lb.	1.25	
Madder	lb.	3.10	
Rhodamines	lb.	6.60	
Toluidine reds	lb.	1.70	
Yellow lakes	lb.	1.22	
Eagle-Picher Basic carbonate White lead	lb.	.19 /	.20
Basic silicate, white lead			
201	lb.	.2075/	.2175
202	lb.	.20 /	.21
Litharge	lb.	.19	
Sublimed	lb.	.1910	
Ferro inorganic colors:			
Black	lb.	1.25 /	1.40
Blues	lb.	1.91 /	2.96
Blue-greens	lb.	1.85 /	2.85
Browns	lb.	.90 /	1.31
Oranges	lb.	2.29 /	4.20
Pink	lb.	1.77 /	1.92
Reds	lb.	2.96 /	4.75
Violets	lb.	1.89 /	2.37
Yellows	lb.	1.26 /	2.90
Harwick Stan-Tones, blues			
Dry	lb.	.90 /	3.45
GPE	lb.	2.50 /	2.85
MBS	lb.	2.20 /	4.55
PC	lb.	1.80 /	1.92
Greens, dry	lb.	.82 /	3.95
GPE	lb.	1.60 /	3.00
MBS	lb.	1.55 /	3.42
PC	lb.	2.20 /	2.32
Oranges, cadmium dry	lb.	2.10 /	4.68
Paste	lb.	2.50 /	3.18
GPE	lb.	1.20 /	1.27
MBS	lb.	1.25 /	2.75

PC	lb.	$0.75 /	$0.80
Reds, cadmium dry	lb.	2.10 /	5.52
Paste	lb.	3.25 /	3.63
Dry	lb.	.98 /	4.60
GPE	lb.	.69 /	3.15
MBS	lb.	1.00 /	3.25
PC	lb.	1.40 /	2.45
Yellows, cadmium dry	lb.	2.80 /	3.18
Paste	lb.	1.77 /	1.89
Dry	lb.	.69 /	2.55
GPE	lb.	.69 /	3.25
MBS	lb.	1.30 /	2.20
PC	lb.	.55 /	3.40
Hiblak AE	lb.	.095 /	.10
Huber pigments:			
WYEX, EPC	lb.	.0725/	.135
Zeolex 7	lb.	.085 /	.095
23	lb.	.06 /	.07
Interchemical IC Series			
Black	lb.	.56	
Blues	lb.	.75 /	2.16
Browns	lb.	.64 /	.69
Greens	lb.	.90 /	.99
Oranges	lb.	.78 /	.89
Reds	lb.	1.16 /	2.50
White	lb.	.70	
Yellows	lb.	.95 /	1.65
Kentucky inorganics,			
Orange	lb.	.44 /	.64
Yellows	lb.	.31 /	.66
Organics,	lb.	3.00 /	4.15
Greens	lb.	3.50 /	4.60
Purple	lb.	1.85 /	2.05
Reds	lb.	1.95 /	3.85
Kriegr-O-Dip W Types	gl.	2.63 /	7.80
A Types	gl.	1.52 /	2.25
Laminac color pastes	lb.	.76 /	1.90
Mearlmaid Pearls	lb.	14.00 /	25.00
Nacromer Pearls, Series C	lb.	2.15 /	2.25
Series W	lb.	1.50 /	1.60
Plastics Color Co., GP colors:			
Blacks	lb.	.75 /	3.80
Blues	lb.	.445 /	.48
Brown	lb.	1.20 /	2.25
Greens	lb.	.65 /	3.50
Reds	lb.	.65 /	3.50
Whites	lb.	.75 /	1.10
Yellows	lb.	1.15 /	1.95
Dispersant 3000	lb.	.50 /	.70
3005	lb.	.40 /	.60
3007	lb.	.80 /	1.00
3008	lb.	.55 /	.75
Special acrylic pastes:			
Aqua, Ivory	lb.	1.15	
Black	lb.	1.90	
Blues	lb.	1.10 /	1.25
Brown, White	lb.	1.05	
Green	lb.	1.55	
Grey, Pink	lb.	1.25	
Red	lb.	2.45	
Yellow	lb.	1.50	
Transparent acrylic pastes:			
Amber	lb.	1.60	
Green	lb.	1.80	
Red	lb.	1.95	
Violet	lb.	2.00	
Yellow	lb.	1.50	
Polyester pastes, aqua	lb.	1.65	
Beige	lb.	1.45	
Black	lb.	1.10	
Blues	lb.	1.20 /	1.30
Brown	lb.	1.35	
Greens	lb.	1.20 /	1.70
Grey	lb.	1.30	
Ivory	lb.	1.30	
Oranges	lb.	1.80 /	2.05
Red	lb.	2.35	
White	lb.	.80	
Yellow	lb.	1.60	
Pliolite S-5 bases with pigment			
Blacks	lb.	.44 /	.49
Blues	lb.	.62 /	1.48
Greens	lb.	.54 /	.58
Oranges	lb.	.61 /	.63
Reds	lb.	.31 /	1.20
Whites	lb.	.42 /	.44
Yellows	lb.	.43 /	.45
PMS polyester colors	lb.	.85 /	2.85
Polystyrene colors	lb.	.65 /	4.30
Polysupra polyethylene			
blues	lb.	.65 /	5.60
Blacks	lb.	.50 /	.80
Browns	lb.	1.48 /	3.30
Greens	lb.	1.82 /	3.55
Ivory	lb.	.65 /	1.00
Purples	lb.	2.10 /	3.30
Reds	lb.	.70 /	6.30
Silver	lb.	1.50 /	2.95
White	lb.	.60 /	.85
Yellow	lb.	1.45 /	4.25
Polystyrene blues	lb.	.50 /	9.20
Blacks	lb.	.50 /	5.30
Browns	lb.	.95 /	2.55
Greens	lb.	.35 /	7.40
Ivory	lb.	.85 /	1.20
Reds	lb.	.35 /	6.40
White	lb.	.60 /	1.05
Yellows	lb.	1.45 /	2.95
R-B-H Pigment Dispersions:			
Blacks	lb.	.66 /	.84
Blues, phthalocyanines	lb.	2.74 /	2.84
Browns	lb.	.82 /	.92
Greens, chrome	lb.	.82 /	.92
Phthalocyanines	lb.	2.35 /	2.45
Orange	lb.	.83 /	.93
Red	lb.	1.88 /	1.98
Whites	lb.	.67 /	.81
Yellow	lb.	.77 /	.87
Resin Plasticizer Pastes:			
Blacks	lb.	$0.52 /	$0.695
Blue	lb.	1.65 /	1.67
Green	lb.	1.64 /	1.66
Orange	lb.	.64 /	.71
Reds	lb.	1.27 /	2.06
White	lb.	.51 /	.53
Yellows	lb.	.51 /	.59
Vinyl Extrusion Chips:			
Blacks	lb.	.895 /	1.09
Blues, iron	lb.	1.03 /	1.13
Phthalocyanine	lb.	2.45 /	2.55
Brown	lb.	.83 /	.93
Green, chrome	lb.	.91 /	1.01
Phthalocyanine	lb.	2.46 /	2.56
Oranges	lb.	.825 /	.97
Purple	lb.	3.36 /	3.46
Reds	lb.	1.605 /	1.705
White	lb.	.73 /	.83
Yellow	lb.	.795 /	.895
R-C blacks	lb.	5.50 /	21.30
Browns	lb.	4.375 /	15.75
Reds	lb.	.28 /	15.05
Yellows	lb.	3.60 /	14.05
Reichhold inorganic pigments:			
Blues, iron	lb.	.53	
Milori, pre-wet	lb.	.3625	
Greens, chrome	lb.	.42 /	.44
Reduced 25%	lb.	.19	
Oranges, chrome	lb.	.35	
Molybdate	lb.	.48	
Yellows, chrome	lb.	.35	
Zinc	lb.	.29 /	.34
Res-N-Dye (dry wt.)	lb.	7.50	
Rona Natural Pearl Essence:			
Radiant	lb.	16.00	
Supreme	lb.	19.00	
Synthetic Pearlescent Pigments:			
100	lb.	2.25 /	2.50
200, 300	lb.	1.30 /	1.45
1000	lb.	2.05 /	2.15
1025	lb.	3.60 /	4.00
2100	lb.	3.30 /	3.45
KY	lb.	6.50	
NLY	lb.	3.40 /	3.50
RAL	lb.	2.15 /	2.45
S5	lb.	6.50	
Saran colors	lb.	.59 /	1.80
Sherwin-Williams Dispersed			
Colors	lb.	.55 /	1.97
Inorganic colors, oranges,			
yellows	lb.	.32 /	.45
Organic colors, blues	lb.	.90 /	3.60
Greens	lb.	1.35 /	3.95
Reds	lb.	.85 /	4.40
Yellows	lb.	.55 /	1.97
Vansul Organic Drys			
Blues	lb.	3.45 /	3.60
Greens	lb.	1.35 /	3.95
Oranges	lb.	2.21 /	3.00
Reds	lb.	.90 /	4.40
Yellows	lb.	2.00 /	2.25
VAP Dry Dispersions			
Black	lb.	1.00	
Blues	lb.	2.90 /	3.60
Greens	lb.	3.20 /	4.05
Oranges	lb.	1.45 /	2.55
Reds	lb.	1.70 /	4.45
Yellows	lb.	1.35 /	2.55
VP-Series Pastes			
Black	lb.	.70	
Blue	lb.	1.65	
Brown	lb.	1.55	
Green	lb.	2.05	
Oranges	lb.	.80 /	2.30
Reds	lb.	1.15 /	2.55
White	lb.	.47 /	.65
Yellows	lb.	.60 /	1.65
VPE-Series Pastes			
Black	lb.	.90	
Blue	lb.	1.85	
Green	lb.	2.10	
Orange	lb.	1.00	
Reds	lb.	1.45 /	2.30
White	lb.	.90	
Yellows	lb.	1.60 /	2.00
VY Chips			
Blacks	lb.	.90 /	1.30
Blues	lb.	1.00 /	2.25
Brown	lb.	1.60	
Greens	lb.	.90 /	2.45
Oranges	lb.	1.00 /	2.15
Reds	lb.	1.40 /	2.70
White	lb.	.65	
Yellows	lb.	.85 /	1.80
Vinylized colors, blacks,			
whites	lb.	.755	
Blues	lb.	1.16 /	1.18
Golds	lb.	1.51	1.57
Green	lb.	1.45	
Metallic	lb.	1.15	
Orange	lb.	.83	
Reds	lb.	1.15	2.27
Yellows	lb.	.7¢	1.09
Violite 199, green	lb.	2.95	
200, yellow	lb.	3.75	
PL 3-60, blue	lb.	3.25	
18-70, blue	lb.	3.70	
Williams colors & pigments:			
Blacks, iron oxide	lb.	.1425,	145
Browns, iron oxide	lb.	.1525/	.155
Burnt umbers	lb.	.0775/	.095
Greens, chromium oxide	lb.	.42 /	.4875
Reds, 100 series, 1,000			
series, RY series	lb.	.1375/	.14
Kromas	lb.	.1375/	.15
Yellows, iron oxide	lb.	.115 /	.1225
Witcoblak 12	lb.	$0.0725/	$0.14
32	lb.	.1225/	.20
50	lb.	.0975/	.175
100	lb.	.26 /	.34
Pellets	lb.	.26 /	.34
F-1	lb.	.0575/	.12
Hitone	lb.	.36 /	.44
Pellets	lb.	.36 /	.44
Zopaque, anatase	lb.	.255 /	.265
Rutile	lb.	.265 /	.285

Dispersing Agents

Downey & Almy Daxads:			
11, 15, 23, 27	lb.	.201 /	.30
11KLS	lb.	.248 /	.35
11SPN	lb.	.1525/	.1575
21	lb.	.08 /	.20
30	lb.	.185 /	.25
Tamol 731	lb.	.185 /	.1875

Fillers

Advaresin CXF	lb.	.49 /	.55
KF	lb.	.38 /	.44
A. F. D.	ton	26.50 /	60.00
Albacar 5950, 5960, 5970	ton	50.00 /	55.00
Aluminum Flake	ton	23.50 /	30.00
Anhydrous calcium sulfate			
W-1320	ton	47.00 /	52.00
Atomite	ton	32.50	
Barytes, No. 1	ton	45.00 /	65.75
Burgess Iceburg Pigment	ton	50.00	
Pigment No. 30	ton	37.00	
Cab-o-sil	lb.	.68 /	.75
Calcene NC	lb.	.036 /	.059
TM	lb.	.0375/	.0625
Camel—CARB	ton	12.00	
—TEX	ton	20.00	
—WITE	ton	32.50	
Cotton flocks	lb.	.12 /	.32
Crown Clay	ton	14.00	
Dixie Clay	ton	14.00 /	34.50
Duramite	ton	20.00	
Emerson & Cuming Filler			
BA	lb.		2.00
English Mica:			
Waterground mica 160			
mesh	lb.	.08 /	.0875
325 mesh	lb.	.0825/	.09
Georgia Kaolin clays:			
Hydri te	ton	26.00	
Flat	ton	25.00	
PD-10	ton	49.00	
PD-121	ton	20.00	
PX	ton	41.00	
Harwick fillers:			
Clays, Champion	ton	14.00 /	36.00
Harwick	ton	20.50 /	55.80
Flock, white	lb.	.11 /	.28
Colored	lb.	.11 /	.19
Magnesium carbonate	lb.	.105 /	.13
Magnesia, tech.	lb.	.055 /	.345
Mica, Silversheen	lb.	.08 /	.0875
Pecan shell flour	ton	45.00 /	106.00
Stan white 325	ton	11.50 /	23.50
Walnut shell flours:			
100W, 200WD	ton	50.00 /	60.00
200W	ton	60.00 /	70.00
200WB	ton	62.00 /	72.00
325W	ton	74.00 /	84.00
Hi-Sil 101	lb.	.10 /	.155
233	lb.	.09 /	.105
Huber Clays:			
Coating grade X-44	ton	21.00 /	26.00
Hydrasperse	ton	21.50 /	34.00
Hi-White R	ton	18.50	
Paragon	ton	14.50 /	18.50
Polyfil	ton	20.00	
Suprex	ton	14.00 /	19.00
Water-washed SWW,			
CWF	ton	12.00 /	17.00
Kalite	ton	50.00 /	65.00
Kaolloid	ton	10.50	
Laminar	lb.	.015	
Maglite	lb.	.2525/	.26
Marinco	lb.	.105 /	.13
McMamee Clay	ton	13.50 /	33.00
Minerals & Chemical Corp.:			
Edgar ASP 200	ton	43.00	
ASP 400	ton	24.00	
ASP 600	ton	25.00	
ASP 900	ton	19.50	
ASP 1300	ton	80.00	
Multiflex MM	ton	110.00 /	125.00
Nytal 200L	ton	27.00 /	50.00
300	ton	37.00 /	60.00
Omya BSH	ton	45.00	
Plymouth Cordage Sisal			
Fibers	lb.	.1825/	.20
Secco Clay	ton	12.00	
Silene EF	lb.	.06 /	.07
Sno-Brite Clay	ton	12.50	
Snowflake	ton	20.00	
Sparmite	ton	80.00 /	105.00
Surtex MM	ton	37.00 /	52.00
Suspenso	ton	33.00 /	48.00
Tamms Satin Talc	ton	22.50 /	46.00
Velveteen R Silica	ton	23.00 /	28.00
U.S. Mica, dry grind	lb.	.04 /	.065
Witcarb P	ton	110.00 /	140.00
R	ton	120.00 /	150.00
Regular	ton	56.75 /	85.00
Wollastonite F-1	ton	23.00 /	25.00
P-1	ton	25.00 /	27.00

Finishes

Logoquant colors	gal.	$3.25 /	$6.30
Toy gloss, acetate	gal.	2.35 /	4.30
Metal	gal.	2.45 /	4.10
Polystyrene	gal.	2.45 /	4.70

Flame-Proofing Agents

IC-776 Antimony Concentrate	lb.	.495 /	.51
M&T Antimony oxide	lb.	.245 /	.26

Glass Reinforcements

Chrome 60-end Roving:			
FBF-7.1, -7.3	lb.	.40 /	.44
FBF-7.5, -7.7	lb.	.42 /	.46
Garan 60-end Roving:			
FBF-7.2, -7.4	lb.	.42 /	.46
FBF-7.6, -7.8	lb.	.44 /	.48
Vitron 60-end Roving:			
VR-12	lb.	.48 /	.52

Lubricants

Advawax 280	lb.	.365 /	.39
Baselube	qt.	2.50 /	4.00
Dow Corning 7 Compound	lb.	5.30 /	6.50
20 Compound	lb.	1.74 /	4.95
20 Emulsion	lb.	.90 /	3.50
36 Emulsion	lb.	1.22 /	1.40
Mold Release Fluid	lb.	3.20 /	4.75
Garalease 915	gal.	3.80 /	4.50
GE silicone-emulsions	lb.	1.20 /	1.76
IC-500	gal.	2.50	
-571	gal.	3.25	
-793-10	gal.	3.40	
IMS neutral oil spray	can	1.37 /	2.00
Lubrex	lb.	.27 /	.32
Lunn-Lease	gal.	3.80 /	4.25
M-1 Mold Release	lb.	3.00 /	4.00
Metasap barium stearate	lb.	.41 /	.46
Calcium 627	lb.	.40 /	.45
Stearate	lb.	.41 /	.46
Magnesium stearate	lb.	.42 /	.47
ML-4 Separating Film	lb.	.30 /	.40
Mold-Ease Concentrate PCR	qt.	2.50 /	5.85
Mold Release 225	gal.	5.25 /	6.00
235	gal.	6.00	
Mold-Wiz	gal.	4.00 /	6.00
Part-A-Part	gal.	3.05 /	3.75
Partingkote 823	qt.	1.18 /	2.18
Prepoxy	gal.	7.20 /	12.80
Plaskon 8406, 8407	lb.	.30 /	.37
8416, 8417	lb.	.35 /	.42
8429	lb.	.40 /	.47
Poly-Lease 77	16 oz.	1.40 /	1.50
Releasor Wax No. 826	lb.	2.29	
Slide	20 oz.	1.25 /	2.00
Sprits	20 oz.	1.00 /	1.25
SS-452	gal.	2.80 /	4.90
Super King Bomb-Lube	20 oz.	1.75 /	2.50
Toplube	qt.	2.50 /	4.00
Vibrin-VPA Parting Agent	gal.	4.25 /	4.65

Mica

Dry Ground Mica	lb.	.04 /	.063
Mycalex 385 & 400, rods, 18 in. length		.90 /	3.35
Sheets, 14 x 18 inches		5.70 /	22.40
K, rods, 18-in. length		1.80 /	6.70
Sheets, 14 x 18 inches		11.40 /	44.80
Supramica 500, rods, 18-in. length		1.08 /	4.02
Sheets, 14 x 18 inches		6.84 /	26.88
Waterground Mica	lb.	.08 /	.09

Miscellaneous

Dutch Boy Bentone	lb.	.44 /	.60
Ben-A-Gel	lb.	.98 /	1.40
IMS Two-Step Mold Surface Saver	Can	1.50 /	2.00
Metasap Water Proofing Agent 569	lb.	.21	
PMS Purging Compound	lb.	.35	
Ultra violet absorber #9	lb.	5.25 /	5.75

Plasticizers

Adipol 2EH, 10A, XX	lb.	.40 /	.435
BCA	lb.	.43 /	.455
ODY	lb.	.43 /	.465
Admex	lb.	.3325/	.3625
711	lb.	.3525/	.3825
744, 745	lb.	.3925/	.4225
760	lb.	.5725/	.6025
761	lb.	.4425/	.4725
562	lb.	.4825/	.5125
Akron MP	lb.	.305	
Araldite No. 1	lb.	.765 /	1.55
Arnold-Hoffman butyl oleate	lb.	.20 /	.30
Butyl stearate	lb.	.2275/	.2675
Barrett dibutyl phthalate	lb.	$0.30 /	$0.335
Dimethyl phthalate	lb.	.28 /	.315
Plasticizer 136	lb.	.175 /	.21
Benzoflex 2-45	lb.	.26 /	.29
9-88	lb.	.32 /	.35
Cabflex DDA, Di-OA, DOA, ODA	lb.	.425 /	.455
DDP, Di-OP, DOP, ODP	lb.	.305 /	.335
Di-BA	lb.	.4325/	.4625
Di-OZ	lb.	.48 /	.51
HS-10	lb.	.44 /	.47
TCP	lb.	.345 /	.375
Celanese Celluflex 21	lb.	.35 /	.375
23	lb.	.3925/	.4175
112, 179A, 179C, 179EG, Lindol	lb.	.325 /	.36
DBP	lb.	.30 /	.335
DOP	lb.	.28 /	.315
Triphenyl phosphate	lb.	.415 /	.435
Chlorowax 40	lb.	.1525/	.1825
50	lb.	.1675/	.1875
70	lb.	.185 /	.25
70-S	lb.	.21 /	.275
LV	lb.	.1725/	.2025
Columbian Carbon butyl stearate	lb.	.2525/	.3425
Capryl alcohol	lb.	.195 /	.30
Caprylene	lb.	.10 /	.205
Dibenzyl sebacate	lb.	.92 /	1.01
Dibutyl phthalate	lb.	.30 /	.395
Dibutyl sebacate, CP	lb.	.68 /	.77
Dicapryl phthalate	lb.	.27 /	.36
Dihexyl adipate	lb.	.40 /	.495
Dihexyl phthalate	lb.	.30 /	.395
Dihexyl sebacate	lb.	.65 /	.74
Diisodecyl phthalate	lb.	.29 /	.385
Diisooctyl adipate	lb.	.40 /	.495
Diisooctyl phthalate	lb.	.28 /	.375
Diocytl adipate	lb.	.40 /	.495
Dioctyl phthalate	lb.	.28 /	.375
Dimethyl sebacate	lb.	1.30 /	1.39
Dioctyl sebacate	lb.	.60 /	.69
Harchemex	lb.	.24 /	.345
Harflex 300	lb.	.58 /	.675
325	lb.	.4325/	.52
500	lb.	.315 /	.41
Isooctyldecyl phthalate	lb.	.285 /	.38
Methyl ethyl ketone	lb.	.26 /	.365
Sebacic acid, CP	lb.	.77 /	.89
Purified	lb.	.69 /	.81
Conoco H-300	lb.	.06 /	.10
Darex DIBA	lb.	.4325/	.4675
DIBM	lb.	.305 /	.34
DIBP	lb.	.30 /	.335
DIDA, DIOA	lb.	.40 /	.435
DIDP	lb.	.29 /	.325
DIOP, DOP	lb.	.285 /	.32
DOS	lb.	.60 /	.63
Dinopol 235	lb.	.335 /	.37
IDO	lb.	.285 /	.32
MOP	lb.	.29 /	.325
Dow Plasticizer No. 5	lb.	.315 /	.54
Resin 276-V2,-V9	lb.	.265 /	.325
Drapex 3.2	lb.	.40 /	.49
Drew DP-100, DP-200	lb.	.4175/	.46
DP-250	lb.	.4275/	.47
DP-316	lb.	.2925/	.335
DP-317	lb.	.555 /	.5975
DP-520	lb.	.415 /	.4575
SC	lb.	.435	
Dutch Boy Plasticizer NL-A10 (DBP)	lb.	.30	.33
NL-A20 (DOP), NL-A30 (DIOP)	lb.	.305 /	.335
NL-C20 (DOS)	lb.	.61 /	.63
NL-F21	lb.	.395 /	.425
NL-F31	lb.	.44 /	.47
NL-F41	lb.	.48 /	.51
NL-A54	lb.	.295 /	.325
Eastman di(2 ethyl hexyl) adipate, P.E.	lb.	.40 /	.435
DI (2 ethyl hexyl) azelate	lb.	.455 /	.49
Di-(2 ethyl hexyl) phthalate	lb.	.28 /	.315
Di-(2ethylhexyl) sebacate	lb.	.61 /	.645
Di(methoxy ethyl) phthalate	lb.	.425 /	.46
Diisobutyl adipate	lb.	.41 /	.445
Dibutyl phthalate	lb.	.30 /	.335
Diethyl phthalate	lb.	.275 /	.31
Diisobutyl phthalate	lb.	.29 /	.325
Dimethyl phthalate	lb.	.295 /	.33
Dinonyl phthalate	lb.	.28 /	.315
Plasticizer 84	lb.	.27 /	.305
Polymeric plasticizer NP-10	lb.	.50 /	.53
Triacetin	lb.	.365 /	.40
Tributyrin	lb.	.69	
Elastex 10-P, 28-P	lb.	.28 /	.315
18-P	lb.	.285 /	.32
20-A, 60-A	lb.	.40 /	.435
40-P, 48-P	lb.	.27 /	.305
50-B	lb.	.265 /	.30
80-P	lb.	.275 /	.31
90-P	lb.	.29 /	.325
DCHP, cast solid	lb.	.58 /	.59
Granular	lb.	.595 /	.605
Ethox	lb.	.50 /	.525
Flexol 3GH	lb.	.44 /	.46
3G0	lb.	.53 /	.55
4G0	lb.	.325 /	.35
8N8	lb.	.355 /	.38
10-10, 10-A	lb.	.29 /	.315
77-G, 426	lb.	.27 /	.295
380	lb.	.305 /	.33
810	lb.	.285 /	.31
A-26	lb.	.40 /	.425
B-400	lb.	$0.25 /	$0.275
CC-55	lb.	.305 /	.33
DOP	lb.	.28 /	.305
R2H	lb.	.59	
TOF	lb.	.43 /	.455
Flexricin 66	lb.	.3275	
P-4		.30	
P-6	lb.	.37	
P-8	lb.	.32	
Good-Rite GP-233, -235, -236	lb.	.40 /	.435
GP-261	lb.	.285 /	.32
GP-265	lb.	.29 /	.325
GP-266	lb.	.295 /	.33
Harchem butyl stearate	lb.	.2525/	.3425
Capryl alcohol	lb.	.195 /	.30
Caprylene	lb.	.10 /	.205
Dibenzyl sebacate	lb.	.92 /	1.01
Dibutyl phthalate	lb.	.30 /	.395
Dibutyl sebacate	lb.	.68 /	.77
Dicapryl phthalate	lb.	.27 /	.36
Dihexyl adipate	lb.	.40 /	.495
Dihexyl phthalate	lb.	.30 /	.395
Dihexyl sebacate	lb.	.65 /	.74
Diisodecyl phthalate	lb.	.29 /	.385
Diisooctyl adipate	lb.	.40 /	.495
Diisooctyl phthalate	lb.	.28 /	.375
Dimethyl sebacate	lb.	1.30 /	1.39
Dioctyl adipate	lb.	.40 /	.495
Dioctyl phthalate	lb.	.28 /	.375
Dioctyl sebacate	lb.	.60 /	.69
Harchemex	lb.	.24 /	.345
Harflex 300	lb.	.58 /	.675
325	lb.	.4325/	.52
500	lb.	.315 /	.41
Isooctyldecyl phthalate	lb.	.285 /	.38
Methyl hexyl ketone	lb.	.26 /	.365
Sebacic acid, CP	lb.	.77 /	.89
Purified	lb.	.69 /	.81
Harshaw dibutyl phthalate	lb.	.325 /	.385
Kapsol	lb.	.33 /	.355
Kessco flex BCL	lb.	.365 /	.375
BCO	lb.	.355 /	.365
BCP	lb.	.33 /	.36
BCS	lb.	.305 /	.315
BO	lb.	.26 /	.28
BS	lb.	.235 /	.26
DBT	lb.	.64	
DDA, DIOA, DOA	lb.	.40 /	.435
DOZ	lb.	.46 /	.50
MCO	lb.	.3225/	.3525
MCP	lb.	.37 /	.40
MCS	lb.	.33 /	.34
ODA	lb.	.47 /	.50
TRA	lb.	.37 /	.40
KP-23	lb.	.315 /	.32
-90	lb.	.40 /	.435
-140	lb.	.46 /	.485
-201	lb.	.58 /	.59
-220, 260	lb.	.33 /	.365
-555	lb.	.595 /	.60
Kronisol	lb.	.33 /	.365
Kronitex AA, I, K-3, MX	lb.	.325 /	.36
Methox	lb.	.385 /	.41
Monoplex DBS	lb.	.64 /	.665
DCP	lb.	.2925/	.32
DOS	lb.	.58 /	.605
S-38	lb.	.215 /	.24
S-70	lb.	.3925/	.42
S-71	lb.	.45 /	.475
Monsanto dibutyl phthalate	lb.	.30 /	.33
Diethyl phthalate	lb.	.25 /	.28
Dimethyl phthalate	lb.	.275 /	.305
Diphenyl phthalate	lb.	.5175/	.5375
DIDA, DOA	lb.	.425 /	.455
DIDP, DIOP, DOP	lb.	.305 /	.335
HB-20	lb.	.15 /	.17
HB-40	lb.	.22 /	.24
Orthonitrobiphenyl	lb.	.13 /	.15
Tricresyl phosphate	lb.	.325 /	.36
Triphenyl phosphate	lb.	.39 /	.40
Morflex P-50	lb.	.68 /	.71
Naugatuck decylbutyl phthalate	lb.	.27 /	.30
Dibutyl phthalate	lb.	.30 /	.33
Sebacate	lb.	.645 /	.67
Diisooctyl adipate, dioctyl adipate	lb.	.425 /	.455
Diisooctyl phthalate, dioctyl phthalate, Isooctyl decyl phthalate	lb.	.305 /	.335
Dinonyl adipate	lb.	.445 /	.475
Dioctyl sebacate	lb.	.585 /	.61
Epoxy plasticizer	lb.	.335 /	.36
Tricresyl phosphate	lb.	.345 /	.375
Ohio-Apex butyl oleate	lb.	.255 /	.265
Stearate	lb.	.22 /	.255
Diallyl phthalate	lb.	.49 /	.525
Dibutyl phthalate	lb.	.30 /	.335
Di-Carbitol phthalate	lb.	.49 /	.495
Diisobutyl adipate	lb.	.41 /	.445
Diisodecyl phthalate	lb.	.29 /	.325
Dioctyl phthalate	lb.	.28 /	.315
D.I.O.P.	lb.	.28 /	.315
Tributyl phosphate	lb.	.50 /	.535
Ohopex Q-10	lb.	.28 /	.315
R-9	lb.	.3525/	.3775
Paraplex 5-B	lb.	.29 /	.3475
AL-111	lb.	.32 /	.3275
G-20	lb.	.76 /	.7675
G-25	lb.	.76 /	.77
G-40	lb.	.4825/	51
G-50	lb.	.39 /	.4175
G-53	lb.	.4325/	.46
G-60, -61	lb.	.3325/	.36
G-62	lb.	.3525/	.38
RG-2	lb.	.41 /	.6575

RG-7	lb.	$0.33 /	$0.6575
RG-8	lb.	.505 /	.335
RG-10	lb.	.52 /	.5125
Pfizer acetyl tributyl citrate, tech	lb.	.32 /	.5275
Acetyl triethyl citrate, tech	lb.	.36 /	.57
Triethyl citrate	lb.	.4575/	.58
Plasticizer 1	lb.	1.17 /	1.37
Plasticizer 120	lb.	.44 /	.49
Plastoflex #3	lb.	.52 /	.57
#520	lb.	.36 /	.435
DBE	lb.	.50 /	.55
MGB	lb.	.29 /	.37
VS	lb.	.3575/	.3975
Plastolein 9050 DHZ	lb.	.52 /	.56
9055 DGP	lb.	.28 /	.32
9057 DIOZ	lb.	.455 /	.50
9058 DOZ	lb.	.455 /	.50
9078LT	lb.	.40 /	.445
9250 THFO	lb	.3575/	.4025
9404 TGP	lb	.3725/	.4175
9715 & 9720 Polymeric	lb.	.365 /	.41
Polycizer 162, 562, 662	lb.	.285 /	.435
332, 532, 632	lb.	.40 /	.555
Polycon #7, 9, 10, 11	lb	305 /	.335
#30	lb.	.30 /	.33
#31	lb.	.27 /	.30
#40	lb.	.245 /	.275
PX-104	lb.	.30 /	.33
-108, -118, -120, -138	lb.	.305 /	.335
-114	lb.	.27 /	.30
-208, -220, -238	lb.	.425 /	.455
-404	lb.	.645 /	.67
-438	lb.	.585 /	.61
-800	lb.	.325 /	.35
-917	lb.	.33 /	.36
Pycal 40	lb.	.3875/	.4375
60	lb.	.60 /	.635
62	lb.	.80 /	.835
94	lb.	.3275/	.3775
140	lb.	.35 /	.40
170	lb.	.275 /	.325
194	lb.	.2775/	.3275
RC Plasticizers:			
B-17	lb.	.21 /	.245
B18	lb.	.38 /	.4125
BIDP	lb.	.27 /	.305
DIDA, DIOA, DOA, ODA	lb.	.40 /	.435
DIDP	lb.	.29 /	.325
DIOP, DOP	lb.	.28 /	.315
DIOS, DOS	lb.	.60 /	.63
O-16	lb.	.275 /	.3075
ODP	lb.	.285 /	.32
TG-8	lb.	.3125/	.3425
TG-9	lb.	.41 /	.4425
Santicizer 1-H	lb.	.50 /	.51
3	lb.	.46 /	.47
8	lb.	.43 /	.44
9	lb.	.39 /	.42
140	lb.	.325 /	.36
141	lb.	.34 /	.37
160	lb.	.25 /	.28
213	lb.	.27	
214	lb.	.29	
601	lb.	.32	
602	lb.	.305	
B-16	lb.	.4875/	.4975
E-15	lb.	.5075/	.5375
M-17	lb.	.4275/	.4575
Staflex AX	lb.	.43	
BR	lb.	.26 /	.29
CP	lb.	.28 /	.31
DBES, DOS	lb.	.61 /	.635
DIOA, ODA	lb.	.435 /	.465
DIOP, DOP, MP	lb.	.305 /	.335
DOZ	lb.	.48 /	.5075
IXA	lb.	.32 /	.35
KA	lb.	.36 /	.3875
KD	lb.	.44 /	.4675
Witcizer #100	lb.	.26 /	.27
#101	lb.	.31 /	.32
#200	lb.	.195 /	.205
#201	lb.	.235 /	.245
#300	lb.	.30 /	.33
#312, 313	lb.	.305 /	.33
#412	lb.	.435 /	.465

Resins & Molding Compounds

Acrylic

Cadco cast rods	lb.	1.42 /	6.96
Polished	lb.	1.58 /	7.16
Machined rods	ft.	22.00 /	9.54
Tubes	lb.	1.39 /	5.76
Polished	lb.	1.51 /	5.99
Colors	lb.	1.62 /	5.99
Pearl	lb.	1.99 /	6.76
Lucite injection molding powders:			
Colorless, transparent	lb.	55	
Std. colors	lb.	59 /	1.00
Stock colors	lb.	59 /	84
Granular Powders for compression & extrusion	lb.	51 /	75
Plexiglas molding powders:			
Colorless	lb.	55 /	.80
Colors, stock	lb.	59 /	.84
Custom	lb.	59 /	1.00
Sheets, Types I-A & II			
Colorless	sq. ft.	80 /	22.18
Colors	sq. ft.	88 /	1.10
Type R, Colorless	sq. ft.	60 /	12.64
Colors	sq. ft.	69 /	1.07
Type RL, colorless	sq. ft.	1.27 /	1.50
Colors	sq. ft.	1.52 /	1.80
Polycast 1	sq. ft.	.80 /	2.40

Alkyd

Plaskon foundry resin 580-11L	lb.	$0.245 /	$0.275
Molding Compound, Type 411	lb.	.43 /	.60
Type 413, 417	lb.	.57 /	.74
Type 420 black	lb.	.44 /	.695
Type 422 colored	lb.	.51 /	.695
Mottle	lb.	.52 /	.705
Natural	lb.	.49 /	.60
Type 430	lb.	.34 /	.50

Cellulosic

Cellulose acetate:			
Celanese cast & extruded film:			
Standard length rolls, clear	lb.	.67 /	1.01
Colors	lb.	.93 /	1.19
Matte finish	lb.	1.43 /	1.77
Stock & cut sheets, clear	lb.	.033 /	.11
Colors	lb.	.044 /	.136
Matte finish	lb.	.087 /	.162
Celanese cast sheeting:			
Standard length rolls, clear	M. sq. in.	.129 /	1.47
Matte finish	M. sq. in.	.16 /	.657
Tinted	M. sq. in.	.243 /	.722
Stock & cut sheets, clear	M. sq. in.	.145 /	1.55
Matte finish	M. sq. in.	.183 /	.767
Tinted	M. sq. in.	.259 /	.862
Hercocel A, extrusion & injection	lb.	.50 /	.65
Injection, std. colors	lb.	.46 /	.61
Special colors	lb.	.42 /	.45
Lumarith molding compounds:			
Group I	lb.	.50 /	.59
Group II	lb.	.46 /	.55
Group III	lb.	.38 /	.48
Non-stock extruded rolls, clear	M. sq. in.	.13 /	1.28
Colors	M. sq. in.	.16 /	1.50
Extruded sheets, clear	M. sq. in.	.15 /	1.95
Colors	M. sq. in.	.17 /	2.13
Stock extruded rolls, clear	M. sq. in.	.13 /	.88
Colors	M. sq. in.	.16 /	.91
Extruded sheets, clear	M. sq. in.	.15 /	1.67
Colors	M. sq. in.	.17 /	1.67
Poly-Cell Group I	lb.	.50 /	.59
Group II	lb.	.46 /	.55
Group III	lb.	.38 /	.48
Group IV	lb.	.57 /	.66
Group V	lb.	.52 /	.61
Tenite Acetate, Group 1	lb.	.50 /	.59
Group 2	lb.	.46 /	.55
Group 3	lb.	.41 /	.51
Group 4	lb.	.38 /	.49
Group 5	lb.	.65 /	.75
Cellulose acetate butyrate:			
Tenite butyrate	lb.	.62 /	.71
A pearls	lb.	.72 /	.81
Blacks, reprocessed	lb.	.50 /	.58
Cellulose propionate: Forticel	lb.	.63 /	.71
Essence pearls	lb.	.73 /	.81
Reprocessed blacks	lb.	.51 /	.58
Ethyl cellulose:			
Dyeform 720, 721	lb.	1.29 /	1.52
Ethocel PG	lb.	.72 /	.80
Bulk, reg.	lb.	.66 /	.81
Std., 7 cps.	lb.	.71 /	.86
Hercocel E	lb.	.72 /	.88

Epoxy

Araldite 502, 506, 6005			
6010	lb.	.77 /	.86
6020, 6030, 6040	lb.	.80 /	.86
6060	lb.	.75 /	.83
6071, 6075	lb.	.615 /	.6225
6084	lb.	.595 /	.6025
6097	lb.	.6025/	.6125
6099	lb.	.69 /	.6975
Bakelite ERL Series	lb.	.80 /	.995
Emerson & Cuming:			
Eccobild 121	lb.	1.20 /	1.60
127	lb.	3.50 /	3.75
420	lb.	.84 /	.99
430	lb.	.90 /	1.15
470	lb.	2.65 /	3.25
490	lb.	1.50 /	1.70
Epocast 2, 3, 5	lb.	1.33 /	1.77
4-B-2, 4-B, 4-C, 4-C-T, 4-D, Paste	lb.	1.09 /	1.15
Epon 562	lb.	1.52 /	1.77
815	lb.	.80 /	.99
820, 825	lb.	.80 /	.97
834	lb.	.855 /	1.00
864	lb.	.91 /	1.08
864-C-75	lb.	.73 /	.85
1001	lb.	.615 /	.85
1004	lb.	.595 /	.6025
1007	lb.	.605 /	.6125
1009	lb.	.69 /	.6975
Furane CN-502	lb.	1.33 /	1.77
Jet-Kote (with cat.)	gal.	7.50 /	10.00

Maraset 602, 610, 610V, 612B 613, 648	lb.	$1.20 /	$1.70
604A, 607	lb.	1.15 /	1.40
608	lb.	1.17 /	1.65
614A, 631A, 618A, 640	lb.	1.32 /	1.77
645	lb.	1.15 /	1.70
Reichhold Polytool Resins:			
6125, 6130, 6140	lb.	.80 /	1.58
Rezolin L-900, 900W	lb.	1.00 /	1.94
902	lb.	2.41	
906	lb.	1.19 /	1.80
910	lb.	1.086 /	2.34
916, 916A	lb.	1.19 /	1.71
940	lb.	1.285 /	2.29
930A	lb.	1.29 /	1.90
933A	lb.	1.29 /	1.80
953A	lb.	1.665 /	1.99
LT-904	lb.	.996 /	1.83
914	lb.	1.073 /	2.18
932	lb.	1.05 /	1.79
Sealcast 501	lb.	1.55 /	1.65
502, 504, 505	lb.	1.75 /	1.85
503	lb.	1.65 /	1.75
Sealfoam 601	lb.	2.90 /	3.15
602	lb.	3.00 /	3.25
603	lb.	2.50 /	2.75
604	lb.	2.85 /	3.10
Toolplastik packages:			
L-900, L-930	lb.	1.59 /	2.29
L-902	lb.	1.69 /	1.84
L-904	lb.	1.54 /	2.19
L-910	lb.	1.94 /	2.34
L-914	lb.	1.83 /	2.19
L-931	lb.	1.75 /	1.99
L-940	lb.	2.05 /	2.29

Fluorocarbon

Bakelite FGBB-33789, FGEB-34790, FXMA-50590, FXMB-50344	lb.	9.00 /	10.00
FGEB-32788, FXMB-50090	lb.	12.00 /	14.00
FYTD	lb.	11.00 /	13.00
FYTH, FYTS	lb.	8.50 /	9.50
Kel-F Grade 270, 300 High density	lb.	6.50 /	9.00
Low density	lb.	6.00 /	8.50
Grade 300—P-25 High density	lb.	7.50 /	10.00
Low density	lb.	7.00 /	9.50
Grade 500-F, 500-R High density	lb.	7.00 /	9.50
Low density	lb.	6.50 /	9.00
Polyfluoron, high density pellets, grades HT, MT, LT	lb.	6.50 /	9.00
colored	lb.	7.00 /	9.50
Low density pellets, Clear grades HT, MT, LT	lb.	6.00 /	8.50
colored	lb.	6.50 /	9.00
Mikron-atomized powder, clear dispersion grades HT, MT, LT	lb.	8.00 /	10.50
colored	lb.	8.50 /	11.00
Liquid dispersions, 40% HT, MT, LT	lb.	4.20 /	4.40
35% HT, MT, LT	lb.	3.20 /	3.85
30% HT, MT, LT	lb.	3.15 /	3.30
25% HT, MT, LT	lb.	2.65 /	2.75
Teflon 1	lb.	4.50 /	5.55
5	lb.	4.75 /	5.80
6	lb.	7.45 /	8.00
30 aqueous dispersion	lb.	5.60 /	6.85

Melamines

Fiberite 2015 (black & pastels)	lb.	.57 /	.62
Pelleted	lb.	.61 /	.66
Cymel 402	lb.	.51 /	.53
404R, 404T	lb.	.85 /	.95
405	lb.	.45 /	.52
428	lb.	.48 /	.55
430	lb.	.465 /	.535
440	lb.	1.10	
480	lb.	.265 /	.315
1077, 1079	lb.	.45 /	.75
Ungranulated	lb.	.43 /	.73
1500	lb.	.42 /	.55
1502	lb.	.45 /	.58
3020	lb.	.57 /	.72
3024-A	lb.	.67	
3135	lb.	.85 /	1.05
3136	lb.	1.05 /	1.15
P-592, -592-A	lb.	.65 /	.75
Plaskon	lb.	.44 /	.75

Phenolic

91-LD	lb.	1.50 /	2.50
Admires PL-50	lb.	.215	
UP-11	lb.	.2325	
Bakelite general purpose	lb.	.187 /	.3525
BMG-5000	lb.	.19 /	.30
Colors	lb.	.2375/	.435
Chem. resist.	lb.	.23 /	.40
Electrical Insul.	lb.	.2725/	.4125
Heat resist.	lb.	.19 /	.35
Impact resist.	lb.	.24 /	.4025
Barrett foundry resins, liquid	lb.	.2125/	.2425
powdered	lb.	.27 /	.355
Insulation resins	lb.	.15 /	.175

Molding resin 313, 314, 317	lb.	$0.27	$0.285
316	lb.	.295	.31
1502, -3, -4, -5, R-110R	lb.	.25	.265
R-114	lb.	.285	.30
Corfoam 107, 114	lb.	.55	.82
Cyacor 151	lb.	.215	.235
191	lb.	.13	.16
Durez, Brake lining resins:			
8054, powdered	lb.	.35	.39
13848, powdered	lb.	.29	.33
14000, powdered	lb.	.32	.36
Foundry resins:			
18115, liquid	lb.	.22	.23
18123, 18250, powdered	lb.	.265	.275
Resins, rubber compounding:			
12603, lump	lb.	.245	.255
12687, powdered	lb.	.36	.40
13355, powdered	lb.	.275	.315
Resins, wood flour bonding:			
12763, 18520, powdered	lb.	.30	.31
Durite GP	lb.	.195	.24
HR	lb.	.191	.3025
IM	lb.	.24	.415
SG	lb.	.195	.3575
Dyform	lb.	1.10	1.35
Fiberite 1078	lb.	.43	.47
1153	lb.	.47	.50
1164	lb.	.475	.51
1270, 1330, 1332	lb.	.395	.43
1271, 1347, 1389	lb.	.40	.44
1346	lb.	.42	.4925
2015	lb.	.57	.63
4030	lb.	.95	.99
4031	lb.	.635	.65
4035	lb.	.60	.82
6100	lb.	1.10	1.12
FM-926	lb.	.44	.455
-927	lb.	.42	.435
-1132, -3510, -3515	lb.	.40	.43
-1914, -1996	lb.	.39	.405
-10365, -11678	lb.	.68	.715
-11547, -17610	lb.	1.08	1.10
-14111	lb.	.43	.445
-17067	lb.	.85	.865
X409	lb.	.285	.325
G-E molding powders:			
12401	lb.	.31	.41
13408, 12486	lb.	.205	.215
12410, 12420	lb.	1.50	1.60
12432	lb.	.405	.505
12433	lb.	.565	.665
12435	lb.	.25	.35
12439-A, 12466	lb.	.265	.365
12444	lb.	.435	.535
12463	lb.	.415	.515
12467	lb.	.51	.61
12487, 12489, 12884, 12887	lb.	.365	.465
12491, 12493, 12853, 12900, 12901, 12902, 12920, 12921	lb.	.21	.31
12494	lb.	.385	.485
12808	lb.	.50	.60
12809	lb.	.66	.76
12871-A	lb.	.22	.32
12824	lb.	.505	.605
12841, 12906	lb.	.255	.355
Loven LHR-401, -403	lb.	.225	.23
-407, -409	lb.	.60	1.00
-408	lb.	.25	.255
LI-201	lb.	.39	.40
-207	lb.	.475	.48
-209	lb.	.60	1.00
-212	lb.	.425	.43
LM-110, -119	lb.	.19	.195
-101	lb.	.24	.245
-116	lb.	.255	.26
-117	lb.	.225	.23
-118	lb.	.1975/	.2025
LMI-301	lb.	.2525/	.2575
-303	lb.	.345	.35
-304	lb.	.60	1.00
-307	lb.	.3075/	.3125
LMM-801, -803	lb.	.2125/	.2175
-804, -811	lb.	.245	.25
-807	lb.	.215	.22
Marblette 76, 77	lb.	.50	.60
Foam resin 1076	lb.	.50	.60
Plenco foundry resins	lb.	.27	.35
Molding cmpds. gen. purpose	lb.	.185	.235
Heat resist	lb.	.19	.24
Improved impact	lb.	.225	.28
Min. bleed	lb.	.185	.195
Radio & TV	lb.	.20	.215
Stock	lb.	.205	.34
Reichhold Foundry Resins:			
Corciment	lb.	.135	.17
Corovit	lb.	.275	.31
Foundrez, core binder liquids	lb.	.21	.25
Shell molding liquids	lb.	.195	.245
Powders	lb.	.2675/	.3025
Plyophen molding cmpds.:			
5440, 5596, 5655, 5660	lb.	.30	.325
5510, 5510-C	lb.	.34	.365
5657, 5658, 5661	lb.	.315	.34
Reilly general purpose	lb.	.195	.20
Heat & impact resist	lb.	.20	.205
Resinox molding compounds:			
Gen. purpose & heat resist	lb.	.205	.215
Impact	lb.	.255	.3225
Low elec. loss	lb.	.31	.365
Special grade	lb.	.215	.255
Rogers phenolic molding compounds:			
RX 425	lb.	$0.29	$0.295
Special colors	lb.	.34	.405
RX 428	lb.	.355	.36
Special colors	lb.	.42	.465
RX 429	lb.	.365	.37
Special colors	lb.	.395	.48
RX 431	lb.	.4125/	.4175
Special colors	lb.	.455	.55
RX 438	lb.	.4675/	.4725
RX 441, 455	lb.	.32	.325
RX 442	lb.	.3475/	.3525
RX 447	lb.	.5025/	.51
RX 448	lb.	.355	.36
RX 458	lb.	.38	.385
RX 469	lb.	.365	.37
RX 470, 480	lb.	.40	.405
RX 478, 488	lb.	.415	.43
RX 525, 545	lb.	.29	.295
RX 530	lb.	.4125/	.4175
Special colors	lb.	.42	.475
RX 547	lb.	.37	.375
RX 625	lb.	.395	.40
RX 628	lb.	.455	.46
Schenectady shell mold resins	lb.	.26	.28
Synvar molding compounds, PM series	lb.	.205	.2625
Synvaren 640	lb.	.30	.335
920	lb.	.21	.245
935	lb.	.195	.23
9203, 9203A	lb.	.173	.208
Synvaren liquid industrial resins:			
675	lb.	.29	.325
920	lb.	.21	.245
CP-66	lb.	.19	.225
PBL-2	lb.	.33	.365
PBL-218S	lb.	.27	.305
Synvarite GW-1000	lb.	.34	.36
GW-1080, PBL-F, PBL-718	lb.	.37	.39
GW-2400	lb.	.375	.395
PBL-100	lb.	.31	.33
PBL-108FF	lb.	.38	.40
PBL-210, PBL-3301	lb.	.36	.38
PBL-410	lb.	.33	.35
PBL-3311	lb.	.35	.37
PNL-12HL/11, PNL-156HL/24	lb.	.3025/	.3225
PNL-159H, PNL-169H	lb.	.29	.31
PNL-169PD, PNL-179PD	lb.	.28	.30
PNL-355PD	lb.	.315	.335
PNL-1279HL	lb.	.2875/	.3075
PT	lb.	.32	.34
Toolplastik No. 8000	lb.	.68	.72

Polyamide

Fiberfil Nylon G, natural	lb.	1.70	1.90
Standard colors	lb.	1.80	2.20
Nylatron G, GS	lb.	1.75	2.00
Plaskon 8200, 8201 natural	lb.	1.33	1.50
Black	lb.	1.53	1.70
White	lb.	1.43	1.60
Other colors	lb.	1.63	1.80
Spencer Nylon 400, 401, 402	lb.	1.33	1.50
60, 602	lb.	1.48	1.65
601	lb.	1.95	2.10
603, 604	lb.	1.83	2.00
Versamid 115	lb.	.64	.82
Zytel molding powder	lb.	1.435	1.60
Zytel, natural color	lb.	1.18	1.35
Blacks and whites	lb.	1.43	1.80
Colors	lb.	1.63	2.05

Polyesters

Acme 1-501	lb.	.82	.93
1-501A	lb.	.87	.98
1-503	lb.	2.75	3.50
1-510	lb.	.89	1.00
Atlac 363E-02Z, -12Z	lb.	.66	.69
-32Z	lb.	.68	.71
382E	lb.	.57	.60
FP	lb.	.66	.69
Bakelite Polyester resins	lb.	.95	.75
Diall 50-01	lb.	2.45	
50-51	lb.	3.25	3.50
50-52	lb.	3.50	
51-01	lb.	.87	1.15
52-01	lb.	2.25	2.50
52-20-30	lb.	1.50	
Diall 50-01, 50-51, 50-52	lb.	2.75	3.50
51-01	lb.	.87	.98
52-01	lb.	1.95	2.50
52-20-30	lb.	1.30	1.50
Fibercore 1000, 2000	lb.	.50	.65
3000	lb.	.55	.70
G-E polyesters			
AR 401	lb.	.35	.365
AR 403, 480	lb.	.34	.355
AR 403 LS, 480 LS	lb.	.355	.37
AR 493	lb.	.40	.415
AR 499	lb.	.435	.45
AR 501	lb.	.455	.47
Hetron 33	lb.	.39	.405
32A	lb.	.435	.45
92	lb.	.43	.445
93LS	lb.	.485	.50
IC-312, -400, -514, -548, -625, -730, -800	lb.	.35	.385
-312-2	lb.	.365	.38
-336, -382, -706	lb.	$0.37	$0.385
-401	lb.	.44	.455
-420	lb.	.355	.37
-433	lb.	.38	.395
-636, -670	lb.	.48	.495
-638, -689	lb.	.55	.565
-670-2	lb.	.50	.515
-671	lb.	.405	.42
Filled resins	lb.	.255	.54
Laminac 4110	lb.	.33	.345
4111	lb.	.45	.465
4116	lb.	.33	.345
4120	lb.	.39	.405
4123, 4128	lb.	.34	.355
4134	lb.	.46	.475
4146	lb.	.43	.445
4192	lb.	.355	.37
4202	lb.	.55	.565
Marco resins:			
CEL-101, Marcothix 1, 3	lb.	.50	.515
Marcothix 5, 7, 8	lb.	.46	.475
Marcothix 9, MR-31C, -31V	lb.	.37	.385
Marcothix 10, MR-28C, 28V, -37C, -37CX	lb.	.33	.345
MR-28CS	lb.	.35	.365
MR-28H, -41R	lb.	.36	.375
MR-28R, -42R	lb.	.34	.355
MR-28RL, -37RL	lb.	.355	.37
MR-30C	lb.	.44	.455
MR-33C	lb.	.53	.545
MR-40R	lb.	.38	.395
MR-60C	lb.	.41	.425
MR-61H	lb.	.42	.435
Mylar, rolls, types A & C	lb.	2.50	4.80
Type D	lb.	3.00	3.30
Sheets, type A	M. sq. in.	.09	1.11
Type C	M. sq. in.	.09	.15
Type D	M. sq. in.	.53	1.34
Plaskon 911, 920	lb.	.55	.665
941, 942, 951, 9411	lb.	.35	.463
943	lb.	.41	.525
9404	lb.	.365	.48
9406	lb.	.355	.465
9500, 9510, 9511	lb.	.35	.465
9600	lb.	.44	.555
Pleogen 1000, 1001, 1002, 1006, 1007, 1100, 1810	lb.	.34	.355
1150, 1501	lb.	.365	.375
1201	lb.	.50	.51
1300, 1301	lb.	.35	.36
1300LS, 1700, 1813	lb.	.37	.38
1402	lb.	.44	.45
1406	lb.	.46	.47
1602	lb.	.35	.365
1800, 1802	lb.	.45	.46
Polycast 2	sq. ft.	1.89	5.18
3	sq. ft.	1.08	18.00
6	sq. ft.	.66	3.10
7	sq. ft.	.72	7.18
CR-39	sq. ft.	1.25	20.00
Polylite 8000, 8001, 8005, 8007, 8017, 8037, 8173, 8200	lb.	.34	.355
8006, 8008, 8009, 8039, 8166	lb.	.35	.365
8016, 8100	lb.	.365	.38
8050	lb.	.41	.425
8061, 8065	lb.	.44	.455
8120	lb.	.48	.495
8150	lb.	.45	.465
8170, 8237	lb.	.38	.395
8180, 8181	lb.	.36	.375
8400	lb.	.56	.575
Pre-Imp	lb.	.68	.85
Thermaflow 100, 200, 300	lb.	.48	.82
400, 500	lb.	.52	.87
1,000, 2,300	lb.	.34	.55
2,400	lb.	.36	.58
Vibrin 114, 117, 152, 154	lb.	.34	
115A	lb.	.38	
121	lb.	.46	
135	lb.	3.00	
142	lb.	.50	
151	lb.	.35	
152LS-4	lb.	.355	
153	lb.	.40	
X-1633-A	lb.	.49	
X-1636-W	lb.	.585	

Polyethylene

A-C No. 6, 617	lb.	.30	.37
No. 6A, 7, 617A	lb.	.35	.42
No. 615, G-201	lb.	.38	.45
No. 629	lb.	.40	.47
No. 729	lb.	.45	.52
Alathons, Group I	lb.	.35	.43
Group II	lb.	.37	.515
Group III	lb.	.375	.42
Bakelite DE Series	lb.	.43	.725
DYGT	lb.	.54	.69
DYLT, DYNF, DYNH	lb.	.41	.59
DYNJ	lb.	.44	.62
DYNK	lb.	.45	.63
Catalin 15-S	lb.	.41	.59
Grex	lb.	.43	
Marlex, types 2, 9, 15, 35, 50 blacks	lb.	.455	.505
Natural	lb.	.43	.48
Other colors	lb.	.49	1.08
Types, 2F, 9F, 15F, 35F, 50F blacks	lb.	.51	1.10
Natural	lb.	.45	.50
Other colors	lb.	.51	1.10

Petrothene 100, 101, 200, 202, 203, 205, 206, 207, 208, 301	lb.	$0.35	$0.45
300, 300-200	lb.	.465	.565
300-6	lb.	.425	.525
301, electrical grade	lb.	.41	.51
301-6	lb.	.37	.47
301-200, 301-202, 302-506, 560	lb.	.375	.48
302-6	lb.	.39	.49
Poly-Eth 1005, 1407, 1408.5, 2007, 2005, 2006, 2215, 2226, 2235, 2236, 2256, 2405, 2425	lb.	.35	.49
1007, 1008.5, 1009	lb.	.325	.465
3215, 3405	lb.	.375	.515
3226	lb.	.39	.53
3495	lb.	.50	.64
Hi-D 1504, 2504, 3504	lb.	.42	.56
Reynolon 1000, P series	lb.	.60	.80
Rulan 2	lb.	.48	.52
Tenite Group 1	lb.	.41	.45
Group 2	lb.	.43	.47
Group 3	lb.	.46	.50
Group 4	lb.	.39	.43
Group 5, 6	lb.	.50	.72
Group 7	lb.	.60	.82
Group 8	lb.	.70	.92

Silicone

Bakelite GMGA-5001, -5002	lb.	2.75	3.10
5003	lb.	4.00	4.35
5004	lb.	5.40	5.75
Dow Corning 301	lb.	3.60	4.00
2103	lb.	1.55	1.65
2105, 2106	lb.	1.59	1.70

Styrenes

Ampacet, crystal	lb.	.315	.335
Colors, std.	lb.	.345	.365
Special	lb.	.345	.75
Pearl	lb.	.41	.75
Phosphorescent	lb.	.695	1.00
Tinsel	lb.	.41	.67
Confetti	lb.	.51	.70
Bakelite BMC series, nat.	lb.	.45	.685
Colors	lb.	.50	.735
BMS, SMD series, crystal	lb.	.295	.31
Colors, std.	lb.	.335	.35
Special	lb.	.335	.52
RMD series, nat.	lb.	.45	.685
Colors	lb.	.50	.735
TGD series	lb.	.33	.35
Colors, std.	lb.	.36	.38
Special	lb.	.36	1.00
TMD series	lb.	.33	.40
Colors, std.	lb.	.36	.43
Special	lb.	.36	1.00
Catalin, high impact, natural	lb.	.325	.355
Colors, std.	lb.	.355	.385
Special	lb.	.36	1.00
Medium impact, natural	lb.	.325	.355
Colors, std.	lb.	.355	.385
Special	lb.	.355	1.00
Regular grade, crystal	lb.	.305	.325
Colors, std.	lb.	.345	.365
Special	lb.	.345	1.00
Utility black	lb.	.18	.235
Cycolac compounds:			
Natural powders	lb.	.53	.65
Natural & std. color pellets	lb.	.58	.62
Darex Copolymer 3	lb.	.47	.67
43G	lb.	.39	.58
X34	lb.	.42	.61
Latices 3L	lb.	.415	.56
610L	lb.	.30	.46
3020	lb.	.32	.47
Dow Latex: styrene/butadiene	lb.	.295	.57
Resins PS-2&3	lb.	.25	.35
butadiene	lb.	.30	.46
Dylite, expandable beads	lb.	.50	.60
Fiberfil Styrene G, natural	lb.	.55	1.00
Standard colors	lb.	.65	2.00
Koppers, Fibertuff	lb.	.55	1.505
MC-185 series	lb.	.33	.355
-300 series	lb.	.33	1.005
-400 series	lb.	.355	1.005
Regular, crystal	lb.	.295	.315
Colors, std.	lb.	.335	.355
Special	lb.	.335	1.005
Pearl	lb.	.41	1.005
Phosphorescent	lb.	.695	2.005
Kralastic, std. colors	lb.	.50	1.10
Lustrex Hi-Flows 55, 66, 77, and Hi-Heat 99 crystals	lb.	.26	.275
LHA standard colors	lb.	.34	.365
special colors	lb.	.34	1.00
Hi-Test 88 & 89	lb.		
Natural & 844 black	lb.	.32	.34
standard colors	lb.	.345	.385
special colors	lb.	.345	1.00
Marbon resins	lb.	$0.39	$0.46
Plio-Tuf C75, R100	lb.	.37	.45
G85	lb.	.52	.59
P100, std. colors	lb.	.41	.45
Polycast 4	sq. ft.	2.56	11.07
Styron 475, natural	lb.	.33	.35
Colors, std.	lb.	.36	.38
Special	lb.	.36	1.00
Sheets, std.	lb.	.55	.60
Special	lb.	.55	.62
480, natural black	lb.	.38	.40
Colors, std.	lb.	.41	.43
Special	lb.	.41	1.00
647, crystal	lb.	.305	.32
Colors, special	lb.	.345	1.34
66, 688, crystal	lb.	.295	.31
Colors, std.	lb.	.335	.35
Special	lb.	.335	1.00
700, crystal	lb.	.295	.31
Colors, std.	lb.	.335	.35
Special	lb.	.335	1.00
777 colors, std.	lb.	.355	.375
Special	lb.	.355	1.00

Urea

Admirez Foundry Resins, SP-30	lb.	.27	
UP-50	lb.	.105	
Beetle C-4980 Brown	lb.	.1875/	.30
No fines granulation	lb.	.2075/	.32
T-298 Black	lb.	.1875/	.30
MUP series, powder	lb.	.30 /	.49
Special colors	lb.	.30 /	.59
Granules	lb.	.33 /	.52
Special colors	lb.	.33 /	.62
Foundrez core binder	lb.	.105 /	.14
Plaskon molding cmpds.:			
Black & Brown	lb.	.1875/	.30
Other colors	lb.	.30 /	.62
Foundry resins, liquid	lb.	.10 /	.13
Powdered	lb.	.2325/	.2525
Sylplast molding cmpds., granules	lb.	.33	
Powder	lb.	.30	

Vinyls

Bakelite QG-5909	lb.	.35	.585
QG-5921	lb.	.41	.645
5924	lb.	.43	.665
QYNA, QYSM, QYSQ	lb.	.27	.47
QYNV	lb.	.30	.50
QYSJ	lb.	.28	.48
VG-1914, 1918	lb.	.37	.056
1985	lb.	.35	.585
5507	lb.	.31	.545
5544	lb.	.405	.64
5911	lb.	.315	.55
5980	lb.	.32	.555
7734	lb.	.28	.515
9031	lb.	.265	.50
9530	lb.	.275	.51
9960, 9970, 9980	lb.	.335	.57
VAGH	lb.	.55	.75
VMCH	lb.	.41	.61
VYDR, VYNW	lb.	.27	.47
VYHH	lb.	.32	.52
VYLF	lb.	.36	.56
VYNS	lb.	.44	.64
VYNV	lb.	.32	.52
Blacar No. BW-60	lb.	.315	.385
NEMA colors	lb.	.355	.425
No. BW-80	lb.	.405	.455
NEMA colors	lb.	.445	.495
No. PC white, ivory, black	lb.	.285	.335
Other colors	lb.	.325	.375
Darex Everplex A (wet wt.)	lb.	.21	.39
B (wet wt.)	lb.	.22	.40
G (wet wt.)	lb.	.21	.39
Copolymer Y (wet wt.)	lb.	.245	.28
PVA Emulsions (wet wt.)	lb.	.19	.355
Diamond PVC-45, -50	lb.	.27	.33
Dow PVC-100, -111	lb.	.38	.57
Escambia Pearls, 2185, 2200, 2225, 2250	lb.	.27	.47
Exon 402A, 500, 905, 915, 925	lb.	.27	.47
450, 468, 480	lb.	.32	.52
461	lb.	9.75	
470	lb.	.48	.68
471	lb.	.45	.65
481	lb.	.39	.59
485	lb.	.37	.57
654	lb.	.30	.50
Formvar	lb.	.865	1.03
Gelva emulsions	lb.	.19	.205
Granules	lb.	.4175/	.617
Geon 101, 101EP, 103EP, 202	lb.	.27	.45
121	lb.	.30	.48
126	lb.	.28	.46
400X110	lb.	.41	.59
404H1	lb.	.37	.55
409, 426, 427, 428	lb.	.32	.50
503H (polyblend)	lb.	.425	.525
2042, 2046	lb.	.315	.55
Colors	lb.	.365	.60
6373	lb.	.345	.58
Colors	lb.	.395	.63
6461	lb.	.325	.56
Colors	lb.	.375	.61
8372	lb.	.33	.565
Colors	lb.	.38	.615
8539, 8726	lb.	.33	.565
Colors	lb.	.35	.585
8590, 8591, 8592, 8593, 8594, 8595	lb.	$2.00	$2.75
8600	lb.	.275	.51
Colors	lb.	.325	.56
8620	lb.	.27	.505
Colors	lb.	.32	.555
8630	lb.	.425	.66
Colors	lb.	.475	.71
8640	lb.	.35	.585
8650	lb.	.32	.555
8677	lb.	.435	.67
8700A, 8750	lb.	.425	.66
Colors	lb.	.455	.69
8720	lb.	.605	.84
8737	lb.	.33	.565
8740	lb.	.295	.53
8749	lb.	.29	.525
8800	lb.	.44	.675
8801	lb.	.275	.51
Colors	lb.	.325	.56
8802	lb.	.33	.565
Colors	lb.	.38	.615
8804	lb.	.29	.525
8807	lb.	.45	.685
8809	lb.	.37	.605
8810	lb.	.275	.55
8812, 8813, 8814, 8815	lb.	.315	.51
Geon Latex 151, 251	lb.	.26	.32
351	lb.	.32	.38
352	lb.	.28	.34
552, 652	lb.	.37	.43
450x167	lb.	.39	.45
576	lb.	.365	.40
Krene, film	lb.	.505	.655
Sheeting	lb.	.49	.645
Marvinols:			
NF-1005	lb.	.34	.625
NF-1055, 3520	lb.	.275	.56
NF-3020	lb.	.41	.645
NF-3025	lb.	.38	.665
NF-3040	lb.	.3375/	.6225
NF-3045, 3050	lb.	.37	.605
NF-3055	lb.	.285	.57
NF-3060	lb.	.29	.575
NF-3065	lb.	.30	.585
NF-3070, 3075, 3080		.265	.50
NF-3085, 3090, 3095	lb.	.29	.525
NF-3505, 3515	lb.	.36	.595
NF-3510	lb.	.34	.575
NF-4005	lb.	.44	.675
NF-4010, 4015, 4020	lb.	.42	.705
NF-5015, 5020	lb.	.40	.655
NF-5025	lb.	.33	.585
NF-5030	lb.	.29	.545
NR-6015	lb.	.39	.685
NR-6020	lb.	.39	.675
NR-7002, 7045, 7060	lb.	.50	.735
VR-10	lb.	.28	.47
VR-12, -20, -21, -22, -24, -30	lb.	.27	.46
VR-50	lb.	.30	.49
Opalon 410	lb.	.30	.50
505, 510	lb.	.32	.52
1006	lb.	.315	.55
1018	lb.	.28	.515
1028, 1038, 72217, 75167, 75223	lb.	.33	.565
1308	lb.	.27	.505
1406	lb.	.415	.465
1706	lb.	.385	.62
71329	lb.	.275	.51
72285	lb.	.3375/	.5725
75179	lb.	.335	.57
78096	lb.	.395	.63
78197	lb.	.32	.55
78207	lb.	.29	.525
78210, 78211	lb.	.335	.57
78216	lb.	.31	.545
78343	lb.	.285	.52
Plastiflex, std.	lb.	.90	1.10
Novelty	lb.	1.15	1.50
Pliovic AO (dispersion)	lb.	.30	.32
DB80V, DB90V, EDB90V	lb.	.27	.29
Latex 300	lb.	.30	.35
Reynolon, 4000 series	lb.	1.55	2.30
Rolls, 1-mil	sq. yd.	.0625/	.11
Colors	sq. yd.	.0675/	.08
4-mil	sq. yd.	.215 /	.3125
Colors	sq. yd.	.2375/	.255
16-mil	sq. yd.	.81 /	1.19
Colors	sq. yd.	.86 /	.945
Satinflex	lb.	1.15 /	1.50
Vygen 110, 120	lb.	.27 /	.31
1101, 1150	lb.	.425 /	.50
2201	lb.	.48 /	.55

Vinylidine

Dow Latex 744-B	lb.	.26	.42
Resin 565	lb.	.39	525
Saran formulation 115, black, nat.	lb.	.39	.52
Colors	lb.	.44	.69
720 nat.	lb.	.41	.54
Colors	lb.	.46	.71
747 nat.	lb.	.395	.525
761 nat.	lb.	.39	.52
Colors	lb.	.44	.69
820 nat.	lb.	.42	.55
Colors	lb.	.47	.6C
Latices	lb.	.45	.61
Resin F 120	lb.	.58	.65
F242	lb.	.64	.70

Solvents

Enjay acetone	lb.	$0.085 / $0.12
Ethyl ester	gal.	.44
Isopropyl acetate	lb.	.115 / .15
Isopropyl alcohol 91%	gal.	.37 / .60
95%	gal.	.39 / .62
Anhydrous	gal.	.41 / .64
Isopropyl ether	gal.	.30 / .51
Methyl ethyl ketone	lb.	.125 / .16
Secondary butyl acetate	lb.	.1225/ .1575
Secondary butyl alcohol	lb.	.125 / .16

Stabilizers

Advastab B-13-P, BC-105, BC-147	lb.	.75 / .80
BC-12, C-77, C-79, E-82	lb.	.90 / .95
BC-74, BC-30	lb.	.70 / .75
BZ-51, L paste, Z-6, Z-15	lb.	.65 / .70
BZ-155	lb.	.69 / .74
C-21	lb.	1.00 / 1.05
CH-101, CH-201	lb.	.60 / .65
CZ-11	lb.	.95 / 1.00
E-98	lb.	.53 / .58
JCX	lb.	.62 / .67
SN	lb.	.47 / .52
T-10, T-52	lb.	1.90 / 1.95
T-17M	lb.	2.95 / 3.00
T-50LT	lb.	3.20 / 3.25
T-52N	lb.	1.80 / 1.85
T-72, T-671	lb.	2.65 / 2.70
gus Mark C	lb.	.88 / .95
E	lb.	.72 / .85
M	lb.	.68 / .74
PL	lb.	.63 / .69
TT	lb.	.72 / .86
WS	lb.	.98 / 1.11
X	lb.	2.50 / 2.75
XI	lb.	.87 / 1.01
XV	lb.	.92 / .99
XX	lb.	.58 / .65
Barca 10	lb.	.75 / .80
Baker barium ricinoleate	lb.	.70
Calcium ricinoleate	lb.	.55
Zinc vicinoleate	lb.	.60
Dutch Boy Barinac	lb.	.70
Calstar	lb.	.37
Clarite A	lb.	.83
B	lb.	.68
CS-137	lb.	1.25
DS-207	lb.	.55
Dyphos	lb.	.58 / .595
50A	lb.	.34
Dythal	lb.	.395 / .41
Leadstar	lb.	.39
Lectro 60	lb.	$0.2525
Normal lead maleate	lb.	.4475
Normasal	lb.	.46
Pearlescent pigment	lb.	1.00
Plumb-O-Sil-A	lb.	.3075
-B	lb.	.325 / $0.37
-C	lb.	.3475/ .375
Provinite A	lb.	.83
B	lb.	.68
Tribase	lb.	.275
-E	lb.	.2225
Trimal	lb.	.435
Ferro 182	lb.	.70 / .76
200	lb.	1.31 / 1.43
203, 900, 1820	lb.	.88 / 1.00
503	lb.	.28 / .40
541A	lb.	.80 / .92
700	lb.	.47 / .59
703, 1972	lb.	.63 / .75
823	lb.	2.50 / 2.75
840	lb.	3.25
903	lb.	.58 / .70
909	lb.	.91 / 1.01
1203	lb.	1.30 / 1.40
1206	lb.	1.23 / 1.33
1212	lb.	.68 / .80
1825	lb.	.98 / 1.10
1840	lb.	.73 / .85
1976	lb.	.45 / .57
Harshaw 1-V-3	lb.	.43 / .45
1-V-4	lb.	.665 / .70
1-V-7, 1-V-26	lb.	.66 / .68
2-V-4	lb.	.85 / .87
2-V-5	lb.	1.09 / 1.12
5-V-1	lb.	.41 / .43
7-V-2	lb.	.93 / .95
8-V-1	lb.	.88 / .90
8-V-21	lb.	.63 / .65
8-V-100, 10-V-442	lb.	.82 / .84
9-V-1	lb.	.70 / .72
12-V-5	lb.	.73 / .75
12-V-6	lb.	.92 / .94
12-V-63	lb.	.72 / .74
12-V-64	lb.	.68 / .70
19-V-1	lb.	.52 / .54
24-V-1	lb.	1.10 / 1.12
128-V-5	lb.	.86 / .88
Merix AST Concentrate 1001	lb.	.355 / 1.75
Metasap 613-A	lb.	.69
613-B	lb.	.84
613-C	lb.	1.06
621	lb.	.88
624	lb.	.75
Cadmium stearate	lb.	1.40 / 1.44
Fused stearates, calcium 602-A	lb.	.25 / .30
Dibasic lead stearate	lb.	$0.55 / $0.60
Lead 611	lb.	.32 / .37
Lead stearate	lb.	.43 / .48
Nuostable V-1	lb.	.54 / .59
V-2	lb.	.39 / .44
V-10	lb.	.70 / .75
V-20	lb.	1.30 / 1.35
V-21	lb.	1.29 / 1.34
V-30	lb.	.90 / .95
V-31	lb.	.80 / .85
V-40	lb.	.18 / 1.23
V-42	lb.	.65 / .70
V-43	lb.	.75 / .80
V-44	lb.	.90 / .95
V-45	lb.	1.10 / 1.15
V-50	lb.	.49 / .54
V-60	lb.	.37 / .42
V-70	lb.	.68 / .73
V-80	lb.	2.80 / 2.85
V-81	lb.	2.90 / 2.95
Permyl A	lb.	.45 / .57
Stabelan E	lb.	1.40 / 1.50
HR, liquid	lb.	.65 / .75
Paste	lb.	.85 / .95
Powder	lb.	.95 / 1.05
XL	lb.	.55 / .65
Staflex QMXA	lb.	.70
50% in DOP	lb.	.52
OY	lb.	1.00 / 1.20
Stayrite #10	lb.	.33 / .37
#15	lb.	.54 / .57
#20	lb.	.38 / .42
#22	lb.	1.32 / 1.34
#25	lb.	.36 / .40
#70, 75, 80, 90	lb.	.69 / .70
#229	lb.	.47 / .50
P-10	lb.	.40 / .44
Thermolite 12	lb.	2.00 / 2.25
13	lb.	3.10 / 3.78
15	lb.	4.13
17	lb.	2.45 / 2.75
20	lb.	2.95 / 3.25
39	lb.	2.75 / 3.25
91	lb.	3.00
Vanstay C-73 S	lb.	.63 / .65
HT	lb.	.90 / .92
L	lb.	.33 / .35
LN	lb.	.98 / 1.00
R	lb.	.70 / .72
Z	lb.	.67 / .69

Wetting Agents

Advawet 212	lb.	.45 / .50
Merix Wash Concentrate	lb.	2.59 / 3.69
Poly-lube No. 4	gl.	1.45 / 1.94

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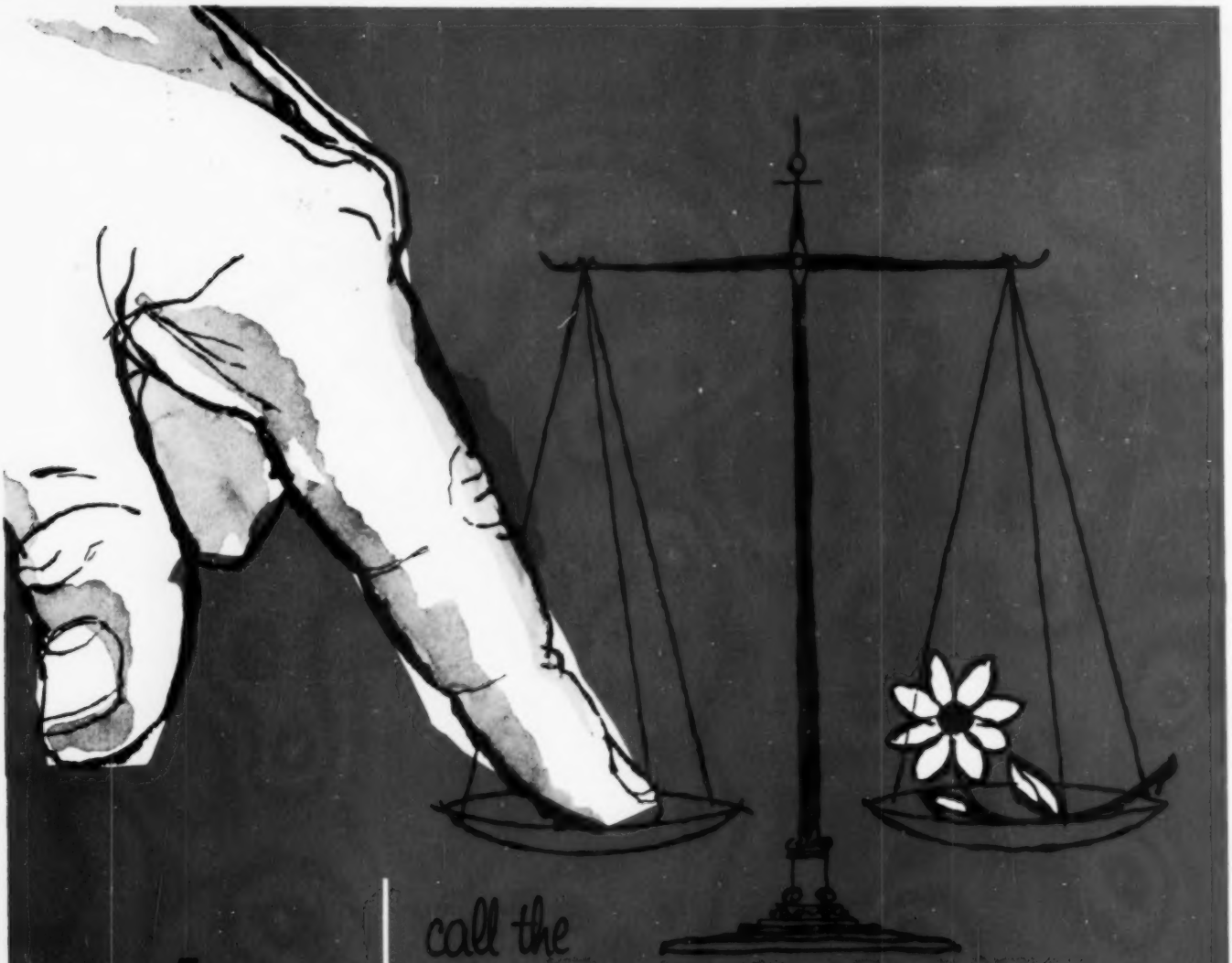

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